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OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

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THE

TRANSACTIONS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

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List of Fellows

OF THE

ENTOMOLOGICAL SOCIETY OF LONDON.

HONORARY FELLOWS.

Date of Election.

1900 Aurivillius, Professor Christopher, *Stockholm.*

1915 Berlese, Professor Antonio, *via Romana*, 19, *Firenze, Italy.*

1905 Bolivar, Ignacio, *Museo nacional de Historia natural, Hipodromo* 17, *Madrid.*

1911 Comstock, Prof. J. H., *Cornell University, Ithaca, New York, U.S.A.*

1894 Forel, Prof. Auguste, M.D., *Yvorne, Canton de Vaud, Switzerland.*

1925 Gestro, Prof. R., *Direttore del Museo Civico di Storia Naturale, Genova, Italy.*

1898 * Grassí, Professor Battista, *The University, Rome.*

1915 ‡ Howard, Dr. L. O., *Chief, Bureau of Entomology, U.S. Dept. of Agriculture, Washington, U.S.A.*

1914 Lameere, Professor A., 74, *rue Defacq, Bruxelles.*

1918 Marchal, Dr. Paul, President of the Entomological Society of France, 45, *rue de Verrières, Antony, Seine, France.*

1913 Tian-Shanski, A. P. Semenoff, *Vassili Ostrov*, 8 *lin.*, 39, *Petrograd, Russia.*

1911 Wasmann, Fr. Erich, S.J., *Valkenburg (L.) Ignatius Kolleg, Holland.*

SPECIAL LIFE FELLOWS.

Date of Election.

1916 (1888) Yerbury, Colonel John W., late R.A., F.Z.S. (Council, 1896, 1903–5), 1, *St. James' Place, St. James's*, S.W. 1.

1923 (1889) Johnson, The Rev. W. F., M.A., 4, *Killowen-terrace, Rostrevor, co. Down.*

FELLOWS.

(*The names of those who have not yet paid either the Entrance Fee or the first year's subscription are not included.*)

Marked * *died during the year* 1925.
Marked † *have compounded for their Annual Subscriptions.*
Marked ‡ *have been admitted into the Society* (*to Dec.* 1925).

Date of Election.

1914†‡Adair, E. W., B.A., 34, *Rue de la Garrigue, Nimes (Gard), France.*

1913 ‡ Adams, B. G., 15, *Fernshaw-road, Chelsea*, S.W.

1902 ‡ Adkin, B. W., *Trenoweth, Hope-park, Bromley, Kent.*
1885 ‡ Adkin, Robert (V.-Pres., 1922; Council, 1901-2, 1911-13, 1921-3), *Hodeslea, Meads, Eastbourne.*
1921 Alexander, Prof. C. P., *Fernald Hall, Mass. Agricultural College, Amherst, Mass., U.S.A.*
1922 Allen, Donald, *Carlton House, Middleton-street, Llandrindod Wells, Rad.*
1920 ‡ Altson, A. M., *Rothamsted Exp. Statn., Harpenden, Herts.*
1924 ‡ Amirthalingan, C., 112, *Gower-street*, W.C. 1.
1911 Anderson, T. J., *Entomological Laboratory, Kabete, Kenya Colony.*
1919†‡ Andrewes, C. H., *Windy Gap, Merton-lane, Highgate*, N. 6.
1910†‡ Andrewes, H. E. (Council, 1920–22), 8, *North-grove, Highgate*, N. 6.
1922 ‡ Andrewes, H. L., c/o John Heelas, Esq., *Queen Anne's Mansions*, S.W.
1899 ‡ Andrews, Henry W., 6, *Footscray-road, Eltham*, S.E. 9.
1901 ‡ Anning, William, 15, *Arthur-street West*, E.C. 4.
1908 † Antram, Charles B., "*The Atal Tea Co., Ltd*," *Siliguri, Darjeeling, India.*
1913 ‡ Armytage, Edward O., *Ingleby, Armytage, Victoria, Australia.*
1907 ‡ Arnold, G., D.Sc., A.R.C.S., *Rhodesia Museum, Bulawayo, South Africa.*
1899†‡ Arrow, Gilbert J. (Council, 1905-7), 9, *Rossdale-road, Putney*, S.W. 15; and *British Museum (Natural History), Cromwell-road*, S.W. 7.
1922 Arthur, Francis, M.R.C.S., L.R.C.P., 395, *Bethnal Green-road*, E. 2.
1911 ‡ Ashby, Edward Bernard, 36, *Bulstrode-road, Hounslow, Middlesex.*
1907†‡ Ashby, Sidney R., 37, *Hide-road, Headstone, Harrow.*
1925 Ashworth, J. H., *The Bungalow*, 151, *St. Andrew's-road South, St. Anne's-on-Sea.*
1921 Atkinson, D. J., *Ataran Forest Division, Moulmein, Burma.*
1886 Atmore, E. A., 2A, *New Conduit-street, King's Lynn.*
1914 Awati, P. R., Medical Entomologist, c/o Grindlay & Co., Bankers, 26, *Westmorland-street, Calcutta.*

1922 ‡ Babault, G., 10, *Rue Camille-Perier, Chaton, Seine-et-Oise, France.*
1904†‡ Bagnall, Richard S., *c/o Middleton & Middleton*, 13, *Grainger-street West, Newcastle-on-Tyne.*
1909 ‡ Bagwell-Purefoy, Capt. Edward, *East Farleigh, Maidstone.*
1903–1913, 1924:
‡ Baldock, G. R., *Oakburn Villa, Hertford-road, Enfield.*
1916 ‡ Balfour, Miss Alice, 4, *Carlton-gardens*, S.W., and *Whittingehame, Prestonkirk, Scotland.*
1921 ‡ Balfour-Browne, Prof. W. A. F., F.R.S.E., F.Z.S. (Council, 1925–), *Winscombe Court, Winscombe, Somerset.*
1912 ‡ Ballard, Edward, 170, *Bowen Terrace, New Farm, Brisbane, Australia.*
1886 ‡ Bankes, Eustace R., M.A.
1890 Barclay, Francis H., F.G.S., *The Warren, Cromer.*

1925 Barnes, W., M.D., *Decatur, Illinois, U.S.A.*
1920 ‡ Barns, T. A., F.Z.S., 22, *Barkston-gardens, Earls Court*, S.W.
1902 ‡ Barraud, Philip J., *Central Research Institute, Kasauli, Punjab, India.*
1907 ‡ Bartlett, H. Frederick D., *Island of St. Helena, S. Atlantic.*
1894†‡Bateson, William, M.A., F.R.S., Fellow of St. John's College, Cambridge, Vice-President (Council, 1925), *The Manor House, Merton, Surrey.*
1908 Bayford, E. G., 2, *Rockingham-street, Barnsley.*
1912 ‡ Baynes, E. S. A., 44, *Primrose Mans., Battersea-park*, S.W. 11.
1896†‡Beare, Prof. Sir T. Hudson, B.Sc., F.R.S.E. (V.-Pres., 1910; Council, 1909–11), 10, *Regent Terrace, Edinburgh.*
1912 Bedford, Gerald, Entomologist to the Union of South Africa, Veterinary Bacteriological Laboratory, *Ondestepoort, Pretoria, Transvaal.*
1913 Bedford, Capt. H. W., *W.T.R. Laboratories, Khartoum, Sudan.*
1899 ‡ Bedwell, Ernest C. (V.-Pres., 1922; Council, 1917–19, 1922–24), *Bruggen, Brighton-road, Coulsdon, Surrey.*
1920 ‡ Beeson, C. F. C., *Indian Forest Service, Forest Research Institute, Dehra Dun, U.P., India.*
1904 Bengtsson, Simon, Ph.D., Lecturer, *University of Lund, Sweden*; Curator, Entomological Collection of the University.
1915 Benham, Prof. W. B., M.A., D.Sc., F.R.S., *University of Otago, Dunedin, New Zealand.*
1925 Benson, R. B., B.A., *St. Catherine's College, Cambridge.*
1906 ‡ Bentall, E. E., *The Grove, Witham, Essex.*
1913 ‡ Best-Gardner, Charles C.
1920 ‡ Bethell, George, F.R.Hist.S., F.L.A., 11, *Chandos-street*, W. 1.
1885 ‡ Bethune-Baker, George T., F.L.S., F.Z.S. (Pres., 1913-14; V.-Pres., 1910–11, 1915; Council, 1895, 1910–15, 1919–21), 20, *Newbold Terrace, Leamington Spa.*
1891 ‡ Blaber, W. H., F.L.S., 34, *Cromwell-road, Hove, Brighton.*
1904*‡Black, James E., F.L.S., *Nethercroft, Peebles.*
1920 Blackmore, E. H., *P.O. Box* 221, *Victoria, B.C.*
1904 ‡ Blair, Kenneth G., B.Sc. (Council, 1918–20), *Claremont*, 120, *Sunningfields-road, Hendon*, N.W. 4.
1921 Blenkarn, S. A., 44, *Rannock Lodge, Grovelands-road, Purley, Surrey.*
1904 ‡ Bliss, M. F., M.C., M.R.C.S., L.R.C.P., *c/o* H. N. Bliss, Esq., 26, *Woodville Gardens, Ealing*, W.
1916 ‡ Bocock, Charles Hanslope, *The Elms, Ashley, Newmarket.*
1912 Bodkin, G. E., Govt. Entomologist, *Mount Carmel, Haifa, Palestine.*
1903 Bogue, W. A., 34, *Handen-road, Lee, S.E.* 12.
1911 * Boileau, H., 99, *Rue de la Côte St. Thibault, Bois de Colombes, Seine, France.*
1921 ‡ Bolton-King, E., *Balliol College, Oxford.*

1913 Chasen, F. W., M.B.O.U., *Raffles Museum, Singapore.*
1919 Chatterjee, N. C., B.Sc., *Forest Research Institute, Dehra Dun, U.P., India.*
1923 Chatterjee, S. N., *Forest Research Inst., Dehra Dun, U.P., India.*
1897 ‡ Chawner, Miss Ethel F., *Forest Bank, Lyndhurst S.O., Hants.*
1913 ‡ Cheavin, W. H. S., F.C.S., F.R.M.S., F.N.P.S., 19, *Rosendale-road, W. Dulwich, S.E.* 21.
1919 Cheesman, Miss L. Evelyn, 20, *Maitland Park Villas, Hampstead,* N.W.
1920 ‡ Cheetham, C. A., *Wheatfield, Old Farnley, Leeds.* All communications to *Stone Bridge Mills, Wortley, Leeds.*
1889 Christy, William M., M.A., F.L.S., *Watergate, Emsworth.*
1909 Clark, Lt.-Col. C. Turner, F.Z.S., *The Hutch, Shirley Warren, Southampton.*
1923 Clarke, C. E., 35, *Octagon, Dunedin, N.Z.*
1914 Cleare, L. D., *Dept. of Science and Agriculture, Georgetown, British Guiana.*
1914 Cleghorn, Miss M. L. W., F.L.S., 12, *Alipore-road, Calcutta.*
1922 Clutten, Wm. George, 136, *Coal Clough-lane, Burnley.*
1908 Clutterbuck, Charles G., *Heathside,* 23, *Heathville-road, Gloucester.*
1908 Clutterbuck, P. H., Inspector General of Forests, *Imperial Secretariat, Delhi, India.*
1904 ‡ Cockayne, Edward A., M.A., M.D., F.R.C.P. (Council, 1915–17), 116, *Westbourne-terrace,* W. 2.
1920 Cockcroft, T., 111, *Owen-street, Wellington South, New Zealand.*
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1917 ‡ Cocks, Frederick, 42, *Crown-street, Reading.*
1914 Coleman, Leslie C., Dept. of Agriculture, *Bangalore, Mysore, India.*
1922 ‡ Collenette, C. L., *Gothic Lodge, Woodford Green, Essex.*
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1918 Comstock, Dr. John Adams, Director, South-Western Museum, *Marmion-way and Avenue, Los Angeles, California, U.S.A.*
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1923 Cottam, R., *Entomological Dept., Wellcome Tropical Research Laboratory, Khartoum, Soudan.*
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1923 ‡ Cox, L. G., 49, *Sussex-square, Brighton.*

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1895 Crabtree, Benjamin Hill, *Holly Bank, Alderley Edge, Cheshire.*
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1911 Davey, H. W., *Cobungua*, 19, *Moama-road, E. Malvern, Australia.*
1913 ‡ Davidson, James, D.Sc., F.L.S. (Council, 1922–24), *Institute of Plant Pathology, Rothamsted, Harpenden, Herts.*
1905 * Davidson, James, 32, *Drumsheugh Gardens, Edinburgh.*
1912 Davis, F. L., J.P., M.R.C.S., L.R.C.P., *Coroxal, British Honduras.*
1910 ‡ Dawson, William George, *Bromley Hill Court, Bromley, Kent.*
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1898 Day, G. O., *Sahlatston, Duncan's Station, Vancouver Island, British Columbia.*
1923 Dean, J. D., *Colin, Llandaff, Glam.*
1923 Dewar, D. A., M.B., C.M., *Altyre House, Stanley S.O., Co. Durham.*
1917 ‡ Dicksee, Arthur, 24, *Lyford-rd., Wandsworth Common*, S.W. 18.
1925 Digges, Rev. J. G., M.A., *Clooncahir, Mohill, co. Leitram, Ireland.*
1887 ‡ Dixey, Frederick Augustus, M.A., M.D., F.R.S., Fellow and Bursar of Wadham College (Pres., 1909–10; V.-Pres., 1904–5, 1911; Council, 1895, 1904–6), *Wadham College, Oxford.*
1921 Dobson, H. W., 14, *Finkle-street, Kendal.*
1909 † Dobson, Thomas, 33, *The Park, Sharples, Bolton.*
1905 Dodd, Frederick P., *Kuranda, viâ Cairns, Queensland.*
1912 ‡ Doig, Major K. A. C., R.A.M.C., M.R.C.S., L.R.C.P., 3, *Hook Heath, Woking.*
1891 ‡ Donisthorpe, Horace St. John K., F.Z.S. (V.-Pres., 1911; Council, 1899–1901, 1910–12), *Durandesthorpe*, 19, *Hazlewell-road, Putney*, S.W. 15.
1921 Dover, C., *St. Joseph's High School, 69, Bow Bazar-street, Calcutta, India.*
1913 ‡ Dow, Walter James, 5, *Great College-street, Westminster*, S.W. 1.
1910 Downes-Shaw, Rev. Archibald, *Scotton Rectory, Gainsborough.*
1924 Druitt, Alan, *Willow Lodge, Christchurch, Hants.*
1900 Drury, W. D., *Dorset House, St. Tobias-road, Sevenoaks.*
1921 du Porte, E. M., *Macdonald College, Quebec, Canada.*
1894 Dudgeon, G. C., C.B.E., 182, *Cromwell-road, S.W. 7.*
1913 Duffield, C. A. W., *Pickersden, Brook Ashford, Kent.*

1906 ‡ Dukinfield Jones, E., *Box* 1831, *Mountain-street, Glendale, California, U.S.A.*

1883 ‡ Durrant, John Hartley (V.-Pres., 1912–13; Council, 1911–13, 1919–21), 20, *Burstock-road, Putney*, S.W. 15; and *British Museum (Natural History), Cromwell-road, S. Kensington*, S.W. 7.

1924 Dutt, A., B.A., B.Sc., Asst. Ent., *Rustam, Dept. of Agric., Baghdad (Iraq).*

1910 ‡ Eales-White, Capt. J. Cushny, 49, *Chester-terrace, Eaton-square*, S.W. 1.

1912 ‡ Earl, Herbert L., M.A., *Vanessa, Rawlyn-road, Torquay.*

1924 Eastham, L., M.Sc., *Zoology Dept., The University, Birmingham.*

1890–1914, 1922:
Eastwood, John E., 14, *Chichester Terrace, Brighton.*

1865 ‡ Eaton, The Rev. Alfred Edwin, M.A. (Council, 1877–9), *Richmond Villa, Northam S.O., N. Devon.*

1902 ‡ Edelsten, Hubert M., *Hillside, Lindfield, Sussex.*

1919 Edwardes, Capt. Tickner, *The Red Cottage, Burpham, Arundel, Sussex.*

1911 ‡ Edwards, F. W., 56, *Norton-road, Letchworth.*

1886 Edwards, James, *Colesborne S.O., Glos.*

1884 ‡ Edwards, Stanley, F.L.S., F.Z.S. (Council, 1912–14), 15, *St. Germans-place, Blackheath*, S.E. 3.

1913 Edwards, William H., *Natural History Dept., The Museum, Birmingham.*

1924 ‡ Edwards, W. H., *Dept. of Agriculture, Reduit, Mauritius.*

1916 ‡ Efflatoun, Bey Hassan, 38, *Shoubrah-avenue, Cairo, Egypt.*

1900 ‡ Elliott, E. A., 41, *Chapel Park-road, St. Leonards-on-Sea.*

1924 Ellis, E. T., F.R.H.S., *Weetwood, Ecclesall, Sheffield.*

1900 ‡ Ellis, H. Willoughby, F.Z.S. (Vice-Pres., 1924; Council, 1916–18, 1922–24), 3, *Lancaster-place, Belsize Park*, N.W. 3.

1919 Elston, Albert H., "*Hatherley*," *Unley Park, S. Australia.*

1925 Elton, C. S., B.A., *Dept. of Comp. Anatomy, University Museum, Oxford.*

1903 ‡ Eltringham, Harry, M.A., D.Sc., F.Z.S. (Secretary, 1922–25; V.-Pres., 1914, 1918; Council, 1913–15, 1918–20), *Woodhouse, Stroud, Gloucestershire*, and *Hope Department, University Museum, Oxford.*

1908 Eustace, Eustace Mallabone, M.A., *Wellington College, Berks.*

1922 Evans, H. Silvester, M.R.C.S., L.R.C.P., *Lomaloma, Fiji.*

1919 ‡ Evans, Lt.-Col. Wm. Harry, D.S.O., R.E., c/o Messrs. Cox & Co., 16, *Charing Cross*, W.C. 2, and *H.Q. Northern Command, Aberfoyle, Simla, India.*

1919 ‡ Falconer, William, 12, *King St., Waterloo, Liverpool.*

1924 ‡ Farmiloe, C., c/o T. & W. Farmiloe, Ltd., *Rochester Row, Westminster*, S.W.

1925 Fassnidge, W., 47, *Tennyson-road, Southampton.*

1907 Feather, Walter, *Cross Hills, nr. Keighley, Yorks.*
1900 ‡ Feltham, H. L. L., *Mercantile Buildings, Summonds-street, Johannesburg, Transvaal.*
1861* ‡ Fenn, Charles, *Eversden House, Burnt Ash Hill, Lee,* S.E. 12.
1920 Fenton, E. W., M.A., B.Sc., *Seale-Hayne Agricultural College, Newton Abbot, Devon.*
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1898 ‡ Fletcher, Prof. T. Bainbrigge, R.N., *Agricultural Research Institute, Pusa, Bihar, India.*
1883 † Fletcher, William Holland B., M.A., *Aldwick Manor, Bognor.*
1905 Floersheim, Cecil, 16, *Kensington Court Mansions,* S.W. 8.
1922 Flower, Miss A. B., "*Eastbury,*" *Surrey-road, Bournemouth West.*
1924 ‡ Ford, E. B., *Wadham College, Oxford.*
1914 Fordham, W. J., M.R.C.S., L.R.C.P., D.Ph., *Whinney House, Low Fell, Gateshead.*
1913 Foster, Arthur H., M.R.C.S., L.R.C.P.(Eng.), M.B.O.U., 13, *Tile-house-street, Hitchin, Herts.*
1898 ‡ Fountaine, Miss Margaret E., *The Studio,* 100a, *Fellow-road, Hampstead,* N.W. 3.
1921 Fox, C. L., 1621, *Vallejo-street, San Francisco, California, U.S.A.*
1920 ‡ Fox-Wilson, G., *Entomological Dept., R.H.S. Laboratory, Wisley, Ripley, Surrey.*
1908 Fraser, Frederick C., Major, M.D., I.M.S., *c/o Grindlay & Co., Parliament-street, Westminster,* S.W.
1888 ‡ Fremlin, H. Stuart, M.R.C.S., L.R.C.P., *Govt. Lymph Establishment, Colindale-avenue, The Hyde,* N.W. 9.
1921 Frew, J. G. H., *Emmanuel College, Cambridge.*
1910 ‡ Frisby, G. E., 29, *Darnley-road, Gravesend.*
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1907 ‡ Fryer, J. C. F., M.A. (Council, 1916–18, 1925), *Milton-road, Harpenden, Herts.*
1876 ‡ Fuller, The Rev. Alfred, M.A., *The Lodge,* 7, *Sydenham-hill, Sydenham,* S.E. 26.

1887 ‡ Gahan, Charles Joseph, M.A., D.Sc. (Pres., 1917–18; V.-Pres., 1916, 1919; Sec., 1899–1900; Council, 1893–5, 1901, 1914–16, 1919), 8, *Lonsdale-road, Bedford Park,* W. 4; and *British Museum (Natural History), Cromwell-road,* S.W. 7.
1920 Gardner, J. C. M., *Forest Research Inst., Dehra Dun, U.P., India.*
1901 † ‡ Gardner, Willoughby, F.L.S., F.S.A., *Deganwy, N. Wales.*
1923 Garrett, F. C., *West Croft, Hexham.*
1922 ‡ Gater, B. A. R., B.A., F.R.M.S., *Dept. of Agriculture, Kuala Lumpur, F.M.S.*

1920 Gauntlett, H. L., M.R.C.S., L.R.C.P., A.K.C., *Van Buren, De Lisle-road, Bournemouth.*

1913 ‡ de Gaye, J. A.

1919 ‡ Gedye, A. F. J., *P.O. Box* 216, *Nairobi, Kenya Colony.*

1923 Gee, C. F., *Springside, Mouldsworth, nr. Chester.*

1922 Ghosh, C. C., B.A., *Agricultural College, Mandalay, Burma, India.*

1915 ‡ Gibson, Arthur, *Dominion Entomologist, Dept. of Agriculture, Ottawa, Canada.*

1908 Giffard, Walter M., *P.O. Box* 300, *Honolulu, Hawaii.*

1895 Gilbert-Carter, Sir G. T., K.C.M.G., *c/o Cox, Biddulph & Co.*, 43, *Charing Cross*, S.W.

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1925 Gilles, W. S., F.I.C., F.C.S., *The Cottage, Bocking, Braintree, Essex.*

1904 ‡ Gilliat, Francis, B.A., 25, *Manor-road, Folkestone.*

1919 ‡ Gimingham, C. T., O.B.E., F.I.C., *Rothamsted Experimental Station, Harpenden, Herts.*

1921 Glick, P. A., *U.S. Dept. of Agric., Tallulah, Louisiana, U.S.A.*

1914 ‡ Godfrey, E. J., Education Dept., *Bangkok, Siam.*

1924 Golding, F. D., *Moor Plantation, Ibadan, S. Provinces, Nigeria.*

1920 ‡ Goodban, B. S., *Watersmeet, West-street, Ewell, Epsom, Surrey.*

1921 ‡ Goodman, O. R., " *Hatchgate,*" *Massetts-road, Horley, Surrey.*

1904 Goodwin, Edward, *Canon Court, Wateringbury, Kent.*

1925 ‡ Gordon, D. J., B.A., *Craigellachie House, Strathpeffer, N.B.*

1898 ‡ Gordon, J. G. McH., *Corsemalzie, Whauphill S.O., Wigtownshire.*

1898 ‡ Gordon, R. S. G. McH., *Drumblair, Inverness.*

1909 Gowdey, Carlton C., B.Sc., *Govt. Laboratory, Hope, Kingston P.O., Jamaica.*

1918 Grace, George, B.Sc., A.R.C.Sc., 23, *Alexander-crescent, Ilkley, Yorks.*

1924 Grant, J. H., *Cole Dale View, Coleshill Road, Ward End, Birmingham.*

1914 Graveley, F. H., *The Indian Museum, Calcutta.*

1911 ‡ Graves, P. P., 17, *Manson Place, Queen's Gate*, S.W. 7.

1891 †‡Green, E. Ernest, F.Z.S., Vice-President (Pres. 1924–4; V.-Pres., 1915; Council, 1914–16, 1925.), *Way's End, Beech-avenue, Camberley.*

1922 Greening, Linnaeus, F.L.S., F.Z.S., 33, *Wilson Patten-street, Warrington.*

1893 † Greenwood, Henry Powys, F.L.S., *Whitsbury House, Salisbury.*

1921 Greenwood, W. F. N., *C.S.R. Co., Lautoka, Fiji.*

1894 ‡ Grimshaw, Percy H., *Royal Scottish Museum, Edinburgh.*

1905 Grist, Charles J., *The Croft, Carol Green, Berkswill, Coventry.*

1920 ‡ Grosvenor, T. H. L., *Springvale, Linkfield-lane, Redhill, Surrey.*

1920 ‡ Gunton, Major H. C., *The Highway, Gerrard's Cross, Bucks.*

1906 Gurney, Gerard H., *Keswick Hall, Norwich.*

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1912 Hacker, Henry, *Queensland Museum, Brisbane, Queensland.*
1919 Hadwen, Dr. Seymour, D.Vet.Sci., *Univ. of Saskatchewan, Saskatoon, Canada.*
1925 ‡ Haig-Thomas, P., *The Grange, Goring-on-Thames.*
1906 ‡ Hall, Arthur, "*Bowness,*" *Brighton-road, Purley, Surrey.*
1924 Hall, J. C., *Shaldon, Upper Park-road, Bromley, Kent.*
1885 ‡ Hall, T. W., *Wood Grange, Shire-lane, Chorley Wood, Herts.*
1921 Hall, W. J., Entomologist, *Ministry of Agriculture, Cairo, Egypt.*
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1915 Hamm, Albert Harry, 22, *Southfield-road, Oxford.*
1891 ‡ Hanbury, Frederick J., F.L.S., *Brockhurst, E. Grinstead.*
1923 ‡ Hancock, G. L. R., *c/o The Department of Agriculture, Box 5, Kampala, Uganda, E. Africa.*
1905 † Hancock, Joseph L., 5454, *University-avenue, Chicago, U.S.A.*
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1917 Harding, William G., F.L.S., M.R.S.L., F.R.H.S., 22, *Arran-road,* S.E. 6.
1903 ‡ Hare, E. J., 4, *New-square, Lincoln's Inn,* W.C. 2.
1920 ‡ Hargreaves, E., *Lands and Forest Dept., Freetown, Sierra Leone.*
1920 Hargreaves, Harry, *The Lindens, Kennington, Ashford, Kent.*
1921 Harland, S. C., D.Sc., *Imperial Coll. of Trop. Agriculture, St. Augustine, Trinidad, B.W.I.*
1925 Harukawa, C., *Ohara Inst., Kuiashiki, Okayama Ken, Japan.*
1910 ‡ Harwood, Philip, *Westminster Bank, Ltd.,* 92, *Wimborne-road Winton, Bournemouth.*
1919 ‡ Hawker-Smith, William, *Speedwell Cottage, Hambledon, Godalming, Surrey.*
1913 †‡ Hawkshaw, Oliver.
1924 Hayward, A. R., *Misterton, Somerset.*
1919 ‡ Hayward, H. C., M.A., *Repton, Derby.*
1921 ‡ Hayward, Capt. K. J., *The Vicarage, Bruton, Somerset.*
1910 ‡ van der Hedges, Alfred, *Overstone-court, Overstone, Northants.*
1919 ‡ Hemming, Capt. Arthur Francis, C.B.E., F.Z.S., 25, *Scarsdale Villas,* W. 8.
1910 Henderson, J., *c/o Messrs. Osborne & Chappel, Ipoh, Perak, Federated Malay States.*
1918 Herrod-Hempsall, Joseph, *Orchard House, Stockingstone-road, Luton, Beds.*
1903 Herrod-Hempsall, William, *W.B.C. Apiary, Old Bedford-road Luton, Beds.*
1925 Hesse, Dr. A. J., *South African Museum, Cape Town, S. Africa.*
1913 Hewitt, John, B.A., Director, *Albany Museum, Grahamstown, S. Africa.*
1923 Hicks, J. B., 99, *Barkston-gardens, S. Kensington,* S.W.
1922 ‡ Higgins, L. G., M.A., F.R.C.S., *Heatherside, Woking, Surrey.*
1924 Hingston, Major R. W. G., *c/o Lloyd's Bank, Bombay.*

1907 ‡ Hoar, T. F. P., *Hillside, Verulam-road, St. Albans, Herts.*
1917 * Hockin, John W., *Castle-street, Launceston.*
1914 Hodge, The Rev. Canon E. Grose, *Halfacre, Heathside Park-road, Woking.*
1912 Hodge, Harold, 99, *Highbury-place*, N. 5.
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1922 Hogarth, A. Moore, 8, *Brentmead Place, Golders Green*, N.W.
1925 Holdaway, F. G., *Zoology Dept., The University, Adelaide, S. Aus.*
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1898 ‡ Holman-Hunt, C. B., *Great Toller, nr. Dorchester, Dorset.*
1922 Hopkins, G. H. E., *Downing College, Cambridge.*
1921 Hopper, L. B., *Manor House, Penryn, Cornwall.*
1901 ‡ Hopson, Montagu F., L.D.S., R.C.S.Eng., F.L.S., 7, *Harley-street*, W. 1.
1919 de Horrack-Fournier, Mme., 90, *Boulevard Malesherbes, Paris*, and *Château de Voisins, Louveciennes, Seine-et-Oise, France.*
1907 † Howard, C. W., *Canton Christian College, Canton, China.*
1888 Hudson, G. V., *Hill View, Karori, Wellington, New Zealand.*
1907 Hughes, C. N., 78, *Harley House*, N.W. 1.
1921 Hunt, Rev. T. Wesley, *Moosin House, Bukoba, Tanganyika Terr.*
1917 Hunter, David, M.A., M.B., *The Coppice, Nottingham.*
1922 ‡ Hutchinson, G. E., *Aysthorpe, Newton-road, Cambridge.*
1923 Hutchinson, J. H., M.A., *Challoner House, Cockermouth.*

1897 ‡ Image, Prof. Selwyn, M.A. (Council, 1909–11), 78, *Parkhurst-road, Camden-road*, N. 7.
1912†‡ Imms, A. D., D.Sc., M.A., F.L.S. (V.-Pres., 1920; Council, 1919–21), *Rothamsted Experimental Station, Harpenden, Herts.*
1920 Inglis, Charles McFarlane, F.Z.S., M.B.O.U., *Baghownie Factory, Laheria Sarai, Bihar, India.*
1918 Isaacs, P. V., B.A., B.Sc., *Agricultural Research Inst., Pusa, Behar, India.*

1907 Jack, R. W., Government Entomologist, Department of Agriculture, *Salisbury, Rhodesia.*
1917 ‡ Jackson, Miss Dorothy J., *North Cliff, St. Andrews, Fife.*
1922 Jackson, W. H., 14, *Woodcote Valley-road, Purley, Surrey.*
1920 James, Russell, 7, *Broadlands-road, Highgate*, N. 6.
1914 ‡ Janse, A. J. T., *1st-street, Gezina, Pretoria, S. Africa.*
1869 ‡ Janson, Oliver E., 44, *Great Russell-street, Bloomsbury*, W.C. 1; and *Cestria, Claremont-road, Highgate*, N. 6.
1898 Janson, Oliver J., 13, *Fairfax-road, Hornsey*, N.

1919 ‡ JEANS, Miss Gertrude M., *Penn Court*, 54, *Cromwell-road*, S.W. 7.
1909 JEPSON, Frank P., M.A., *Dept. of Agric., Peradeniya, Ceylon.*
1917*‡JERMYN, Col. Turenne, *Highcliffe, Weston-super-Mare.*
1886 JOHN, Evan, *Llantrisant S.O., Glamorganshire.*
1907 JOHNSON, C. F., *West Bank, Didsbury-road, Heaton Mersey.*
1917 JOHNSON, Jesse, *c/o del Cónsul de Inglaterra, Guatemala City.*
1924 ‡ JOHNSTON, H. B., M.A., *Wellcome Laboratories, Khartoum, Sudan.*
1920 ‡ JOHNSTONE, Douglas, *Brooklands, Rayleigh, Essex.*
1908 ‡ JOICEY, James J., F.L.S., F.Z.S., F.R.G.S., etc. (COUNCIL, 1921-3), *The Hill, Witley, Surrey.*
1924 JONES, F. M., 2000, *Riverview Avenue, Wilmington, Delaware, U.S.A.*
1920 ‡ JONES, Rev. Neville, *Hope Fountain, Box* 283, *Bulawayo, Rhodesia, S. Africa.*
1924 JONES, W. E., *M'fongosi, Zululand.*
1894†‡JORDAN, Dr. K. (V.-PRES., 1909 ; COUNCIL, 1909–11, 1924–), *The Museum, Tring.*
1910 ‡ JOSEPH, E. G., 23, *Clanricarde-gardens*, W. 2.
1910 ‡ JOY, Ernest Cooper, *Eversley, Dale-road, Purley.*
1902 ‡ JOY, Norman H., M.R.C.S., L.R.C.P., 78, *Crescent-road, Reading.*
1919 JURRIAANSE, J. H., *W.Z. Schiekade*, 75, *Rotterdam, Holland.*

1896†‡KAYE, W. J. (COUNCIL, 1906–8), *Caracas, Ditton Hill, Surbiton.*
1925 KEARNS, H. G. H., B.Sc., *Downing College, Cambridge.*
1890 ‡ KENRICK, Sir George H., *Whetstone, Somerset-road, Edgbaston, Birmingham.*
1920 KENT-LEMON, Capt. Arthur Leslie, York & Lancaster Regt., *c/o Postmaster, Khartoum, Sudan*, and *Blytheswood, Ascot, Berks.*
1904 KERSHAW, G. Bertram, *Ingleside, West Wickham, Kent.*
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1919 KHARE, J. L., *Agricultural College, Nagpur, India.*
1925 KILLINGTON, F. J., A.C.P., 177, *Leigh-road, Eastleigh, Hants.*
1912 ‡ KING, H. H., Govt. Entomologist, *Gordon College, Khartoum, Sudan.*
1889 ‡ KING, James J. F.-X., 1, *Athole Gardens-terrace, Kelvinside, Glasgow.*
1917 ‡ KIRKPATRICK, Thos. W., *c/o Dept. of Agriculture, Nairobi, Kenya Colony*, and *The Deanery, Ely, Cambs.*
1887 † KLEIN, Sydney T., F.L.S., F.R.A.S., *Lancaster Lodge, Kew Gardens, Surrey.*
1920 KNIGHT, V., *Fairgreen Cottage, Glemsford, Suffolk.*

1922 ‡ LACEY, Lionel, *Brooklyn, Solihull, Warwickshire.*
1925 LAIDLAW, F. F., M.R.C.S., F.R.C.P., *Hyefield, Uffculme, Devon.*
1916 ‡ LAING, Frederick (COUNCIL, 1922–24), *Natural History Museum, Cromwell-road*, S.W. 7.
1910 ‡ LAKIN, C. Ernest, M.D., F.R.C.S., 105, *Harley-street*, W. 1.

1924 Lamb, C. G., M.A., Sc.D., 65, *Glisson-road, Cambridge.*
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1921 ‡ Lancum, F. H., 15, *Oakfield-lane, Dartford, Kent.*
1917 Langham, Sir Charles, Bart., *Tempo Manor, Co. Fermanagh.*
1922 Lankester, C. H., *Cartago, Costa Rica.*
1920 Lathy, Percy I., 90, *Boulevard Malesherbes, Paris.*
1916 Latta, Prof. Robert, D.Phil., *University of Glasgow.*
1925 Latter, M. P., F.G.S., *Weald Place, Sevenoaks, Kent.*
1895 Latter, Oswald H., M.A., *Charterhouse, Godalming.*
1899 Lea, Arthur M., Government Entomologist, *Museum, Adelaide, S. Australia.*
1923 Lean, O. B., *Imperial College of Science, South Kensington,* S.W. 7.
1914 Leechman, Alleyne, M.A., F.L.S., F.C.S., *Amani,* near *Tanga, Tanganyika Territory, East Africa.*
1910 Leigh, H. S., *The University, Manchester.*
1900 Leigh-Phillips, Rev. W. J., *Burtle Vicarage, Bridgwater.*
1920 ‡ Leman, G. B. C., *Wynyard,* 52, *West Hill, Putney Heath,* S.W. 15.
1920 ‡ Leman, G. C., *Wynyard,* 52, *West Hill, Putney Heath,* S.W. 15.
1924 ‡ Le Pelley, R. H., *East Malling Research Station, East Malling, Kent.*
1903†‡Levett, The Rev. Thomas Prinsep, *Frenchgate, Richmond, Yorks.*
1925 Levick, J., *Ashley House, Handsworth Wood, Birmingham.*
1876 ‡ Lewis, George, F.L.S. (Council, 1878, 1884), 30, *Shorncliffe-road, Folkestone.*
1908 † Lewis, John Spedan, *North Hall, Mortimer Crescent,* N.W. 6.
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1914 ‡ Lister, J. J., *St. John's College, Cambridge;* and *Merton House, Grantchester, Cambs.*
1865 † Llewelyn, Sir John Talbot Dillwyn, Bart., M.A., F.L.S., *Penllergare, Swansea.*
1925 ‡ Llewellyn Jones, Rev. J. R. J., M.A., "*Newcote,*" *West Avenue, Exeter.*
1919 ‡ Lloyd, Llewellyn, D.Sc., *Azare, Kano, N.P., Nigeria.*
1885†‡Lloyd, Robert Wylie (Vice-Pres. 1924; Council, 1900–1, 1923–25), I, 5 and 6, *Albany, Piccadilly,* W. 1.
1920 ‡ Lodge, George, *Hawkhouse Park-road, Camberley.*
1903 Lofthouse, T. A., *The Croft, Linthorpe, Middlesbrough.*
1925 ‡ Longfield, Miss C., 20, *Pont-street,* S.W. 1.
1908 ‡ Longsdon, D., *The Flower House, Southend, Catford,* S.E. 6.
1920 Loveridge, Arthur, *Museum of Comparative Zoology, Cambridge, Mass., U.S.A.*
1893 * Lower, Oswald B., *Broken Hill, New South Wales, Australia.*
1901 Lower, Rupert S., *Tranmere, Magill-road, Canyton, S. Australia.*
1923 Lowther, R. C., M.B., Ch.B., *Fernleigh, Grange-over-Sands, Lancs.*
1898 ‡ Lucas, William John, B.A. (Council, 1904–6), 28, *Knight's-park, Kingston-on-Thames.*

1903 Lyell, G., *Gisborne, Victoria, Australia.*
1912 ‡ Lyle, George Trevor, *Briarfield, Stump Cross, Shibden, Halifax.*

1922 McConnell, Dr. R. E., "*Ladwood,*" *Wakefield, Rhode Island, U.S.A.*
1910 Macdougall, Professor R. Stewart, M.A., D.Sc., F.R.S.E., 9, *Dryden Place, Blacket Avenue, Edinburgh.*
1922 ‡ Mace, Herbert, *Faircotes, Harlow, Essex.*
1919 McLeod, M. C., *Court Lodge, Ware, Herts.*
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1899†‡Main, Hugh, B.Sc. (Council, 1908–10), *Almondale, 55, Buckingham-road, South Woodford,* N.E.
1892 ‡ Mansbridge, William, *Dunraven, Church-road, Wavertree, Liverpool.*
1919 Mansfield-Aders, Dr. W., *Zanzibar.*
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1925 Marks, E., 20A, *Motcombe-street, Belgrave-square,* S.W. 1.
1920 Marriner, Thomas Frederic, 2, *Brunswick-street, Carlisle.*
1895 ‡ Marshall, G. A. K., C.M.G., D.Sc., F.R.S. (V.-Pres., 1919, 1924 ; Council, 1907–8, 1919–21, 1924–), 6, *Chester-place, Hyde Park-square,* W. 2.
1922 Marshall, J. F., M.A., F.Z.S., *Seacourt, Hayling Island, Hants.*
1896 Marshall, P., M.A., B.Sc., F.G.S., *Hautere, Bellevue-road, Lower Hutt, New Zealand.*
1897 Martineau, Alfred H., *Shutteroaks Toll House, Crewkerne, Somerset.*
1919 Marumo, N., *Zoological Institute, Agricultural College, Imperial University, Komaba, Tokyo, Japan.*
1922 ‡ Massee, A. M., *East Malling Research Station, East Malling, Kent.*
1895 Massey, Herbert, *Ivy-Lea, Barnage, Didsbury, Manchester.*
1865 Mathew, Gervase F., F.L.S., Paymaster-in-chief, R.N. (Council, 1887), *Lee House, Dovercourt, Harwich.*
1921 Matsumura, Prof. S., *Hokkaido Imperial University, Sapporo, Japan.*
1887 Matthews, Coryndon, *Woodside, Salcombe, S. Devon.*
1912 Maulik, Prof. S., *Dept. of Zoology, University of Calcutta, Calcutta, India.*
1900*‡Maxwell-Lefroy, Professor H., *Imperial College of Science and Technology, South Kensington,* S.W.
1916 ‡ May, Harry Haden, *Black Friars Distillery, Southside-street, Plymouth.*
1913 ‡ Meaden, Louis, *Melbourne, Dyke-road, Preston, Brighton.*
1920 ‡ Meldola, Mrs. Ella Frederica, 6, *Brunswick-square,* W.C. 1.
1919 Mellows, Charles, M.A., *The College, Bishop's Stortford.*
1885 Melvill, J. C., M.A., F.L.S., *Meole Brace Hall, Shrewsbury.*

1912 ‡ Metcalfe, Rev. J. W., *St. Luke's House, Torquay.*
1880 ‡ Meyrick, Edward, B.A., F.R.S., F.Z.S., *Thornhanger, Marlborough.*
1883 ‡ Miles, W. H., *c/o E. Step, Esq.*, 158, *Dora-road, Wimbledon Park, S.W. 19.*
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1925 Millott, R. T., *Waverley-road, Mansfield.*
1923 Mitchell-Hedges, F. A., *White Rock, Brockenhurst, Hants.*
1905 ‡ Mitford, R. S., C.B., 9, *Beaconsfield-terrace, Hythe, Kent.*
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1899 ‡ Moore, Harry, 12, *Lower-road, Rotherhithe, S.E. 16.*
1922 Moore, J. W., 151, *Middleton Hall-road, King's Norton, Birmingham.*
1889 † ‡ Morice, The Rev. F. D., M.A., F.Z.S., Fellow of Queen's College, Oxford (Pres., 1911–12; V.-Pres., 1902, 1904, 1913, 1919; Council, 1902–4, 1918–20). *Brunswick, Mount Hermon, Woking.*
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1895 † ‡ Morley, Claude, F.Z.S., *Monk Soham House, Suffolk.*
1920 ‡ Morris, H. M., M.Sc., *Rothamsted Experimental Station, Harpenden, Herts.*
1893 Morton, Kenneth J., 13, *Blackford-road, Edinburgh.*
1910 ‡ Mosely, Martin E., 94, *Campden Hill-road, Kensington, W. 8.*
1882 Mosley, S. L., *Ravensknowle Museum, Huddersfield.*
1911 ‡ Moss, Rev. A. Miles, *c/o Messrs. Booth & Co., Para, Brazil.*
1907 † ‡ Moulton, John C., O.B.E., M.A., B.Sc., F.Z.S., etc., *Kuching, Sarawak* (via *Singapore*).
1911 Mounsey, J. Jackson, *Bryn-Tirion, Kingstone, Hereford.*
1922 ‡ Moysey, Capt. Francis, *c/o Col. R. H. Rattray*, 68, *Dry Hill Park-road, Tonbridge, Kent.*
1901 † ‡ Muir, Frederick, *H.S.P.A. Experiment Station, Honolulu, Oahu, H.I.*
1912 † Mullan, Jal P., M.A., F.L.S., F.Z.S., Professor of Biology, *St. Xavier's College, Lamington-road, Grant Road Post, Bombay, India.*
1925 Mumford, E. P., *Christ's College, Cambridge.*
1920 Munro, H. K., B.Sc., *P.O. Box* 513, *Pretoria, S. Africa.*
1918 Munro, James W., D.Sc., *Green Lawn, Kew-road, Richmond, Surrey.*
1914 Murray, George H., *The Residency, Kerema Gulf Division, Papua.*
1917 Muschamp, Percy A. H., 35, *Upperton-road, Leicester.*
1922 Musgrave, A., *Australian Museum, Sydney, N.S.W.*
1909 Musham, John F., *Well House, Pennybridge, Ulverston, Lancs.*
1920 Myers, J. G., *c/o Bussey Institution, Forest Hills, Boston, Mass., U.S.A.*

1921 Nair, K. P. U., *Training College, Trivandrum, India.*
1903 ‡ Neave, S. A., M.A., D.Sc., F.Z.S. (Secretary, 1919– ; V.-Pres., 1918 ; Council, 1916–18), 41, *Queen's Gate*, S.W. 7, and *Bishop's House, Beaconsfield, Bucks.*
1919 ‡ Nell, Louis, *Imperial Bureau of Entomology*, 41, *Queen's Gate*, S.W. 7.
1919 Nelson, W. G. F. (Council, 1922–24), 6, *Bolton Street*, W. 1.
1923 Nevill, T. N. C., 48, *Sloane-square*, S.W.
1901 ‡ Nevinson, E. B., *Morland, Cobham, Surrey.*
1923 ‡ Newland, Gordon, 19, *Bath-road, Bedford Park*, W. 4.
1907 ‡ Newman, Leonard Woods, *Bexley, Kent.*
1913 Newman, L. J. W., *Bernard-street, Claremont, W. Australia.*
1909 Newstead, Alfred, *The Grosvenor Museum, Chester.*
1890 ‡ Newstead, Prof. Robert, M.Sc., F.R.S., A.L.S., Hon. F.R.H.S., Dutton Memorial Professor of Entomology, *The School of Tropical Medicine, University of Liverpool.*
1921 Nicholson, A. J., *University of Sydney, New South Wales, Australia.*
1914 ‡ Nicholson, Charles, 35, *The Avenue, Hale-end, Chingford*, E. 4.
1909 ‡ Nicholson, Gilbert W., M.A., M.D. (Council, 1913–15), *Oxford and Cambridge Club, Pall Mall*, S.W. 1.
1918 ‡ Nimmy, E. W., "*Zennor,*" *Oxhey-road, Watford, Herts.*
1906 Nix, John Ashburner, *Tilgate, Crawley, Sussex.*
1915 Northcote, Dr. A. B., 4, *Columbia-road, Bethnal Green*, E. 2.
1923 Notman, H., F.S.A., 136, *Joralemon-street, Brooklyn, New York.*
1895 Nurse, Lt.-Col. C. G., *Redcote, Rusthall Park, Tunbridge Wells.*

1877 Oberthür, René, *Rennes (Ille-et-Vilaine), France.*
1910 ‡ Oldaker, Francis A., M.A., *The Red House, Haslemere.*
1921 Ollenbach, O. C., *Survey of India Dept., Dehra Dun, India.*
1925 Onslow, F. R. D., 10, *Keswick-road, East Putney*, S.W.
1913 ‡ Ormiston, Walter, *Kalupatrani, Haldummulle, Ceylon.*

1895 ‡ Page, Herbert E. (Council, 1918–20), *Bertrose, Gellatly-road, St. Catherine's Park*, S.E. 15.
1921 Pallis, M. A., *Tatoi, Aigburth Drive, Liverpool.*
1916 Palmer, A. Ray., *Standeford, Baldock-road, Letchworth, Herts.*
1919 Paravicini, Louis, *Commissioner de la Bourse de Bâle, Bâle, Switzerland.*
1918 ‡ Parris, R. Stanway, *Raymond House, Bramley, Guildford.*
1919 Patton, Major W. S., I.M.S., 34, *York-road, Trinity, Edinburgh.*
1922 ‡ Pearce, Edmund J., *The Lodge, Corpus Christi College, Cambridge.*
1922 ‡ Pearce, Miss E. K., *East Morden, Wareham, Dorset.*
1911 ‡ Pearson, Douglas, *Chilwell House, Chilwell, Notts.*
1916 ‡ Peebles, Howard M., 71, *Cadogan Gardens*, S.W. 3.
1919 Peed, John, *Aylsham, Norfolk.*
1915 ‡ Peile, Lt.-Col. H. D., I.M.S., *Rawdon*, 25, *De la Warr-road, Bexhill-on-Sea.*

1921 ‡ Pendlebury, H. M., *Broadlands, Shrewsbury*; Systematic Entomologist, *Federated Malay States.*

1914 ‡ Pendlebury, Wm. J. von Monté, M.A., *Broadlands, Shrewsbury.*

1922 ‡ Perkins, M. G. L., 4, *Dean's-yard, Westminster Abbey*, S.W. 1.

1903 † Perkins, R. C. L., M.A., D.Sc., F.R.S., 4, *Thurlestone-road, Newton Abbot, Devon.*

1907 † Perrins, J. A. D., 3rd Seaforth Highlanders, *Davenham, Malvern.*

1897 ‡ Phillips, Capt. Hubert C., F.Z.S., M.R.C.S., L.S.A., 17, *Hereford-road, Bayswater*, W. 2.

1903†‡Phillips, Montagu A., F.R.G.S., F.Z.S., *c/o Dr. Phillips*, 57, *St. George's-square*, S.W.

1920 Philpott, A., Assistant Entomologist, Biological Dept., *Cawthron Institute of Scientific Research, Nelson, New Zealand.*

1922 ‡ Piazza, E., 4734, *48th-street, San Diego, California, U.S.A.*

1917 ‡ Pickard-Cambridge, Arthur W., M.A., *Balliol College, Oxford.*

1891 ‡ Pierce, F. N., *The Old Rectory, Warmington, Oundle, Northants.*

1913 Platt, Ernest Edward, 403, *Essenwood-road, Durban, Natal.*

1885 * Poll, J. R. H. Neerwort van der, *c/o J. Stroere, B.Z. Prinsen-gracht*, 1005, *Amsterdam.*

1919 Pomeroy, Arthur W. Jobbins, Government Entomologist, *Ibadan, S. Nigeria.*

1870†‡Porritt, Geo. T., F.L.S. (Council, 1887), *Elm Lea, Dalton, Huddersfield.*

1884†‡Poulton, Professor Edward B., D.Sc., M.A., F.R.S., F.L.S., F.G.S., F.Z.S., Hope Professor of Zoology in the University of Oxford, President (Pres., 1903–4; V.-Pres., 1894–5, 1902, 1905, 1922–3; Council, 1886–8, 1892, 1896, 1905–7, 1922–4), *Wykeham House, Banbury-road, Oxford.*

1905 Powell, Harold, 7, *Rue Mireille, Hyères (Var), France.*

1921 Powniah, D., *Agricultural Dept., Kuala Lumpur, Fed. Malay States.*

1919 Praed, C. W. M., *Dalton Hill, Albury, Surrey.*

1878 Price, David, 12, *Worthing-road, Horsham.*

1922 Price, J., 165, *Corporation-street, Stafford.*

1908 ‡ Prideaux, Robert M. (Council, 1917), *Woodlands, Brasted Chart, Sevenoaks.*

1920 ‡ Prior, W. H. T., *Culban, Main-road, New Eltham, Kent.*

1904 ‡ Priske, Richard A. R., 9, *Melbourne Avenue, West Ealing.*

1920 Prout, Miss Alice Ellen, *Lane End, Hambledon, Surrey.*

1893 ‡ Prout, Louis Beethoven (Council, 1905–7), 84, *Albert-road, Dalston*, E. 8.

1924 Pruthi, H. Singh, *Zoological Laboratory, University of Cambridge.*

1910 Punnett, Professor R. C., M.A., *Caius College, Cambridge.*

1922 ‡ Rae, Mrs. Margaret, *Courthill, Birkenhead.*

1923 ‡ Raff, Miss Janet W., M.Sc., *c/o The Biology School, University of Melbourne, Victoria, Australia.*

1912 ‡ Rait-Smith, W. (Council, 1924–), *Birkby House, Bickley Park, Kent.*

1924 ‡ Ralfs, Miss E. M., *Montford, King's Langley, Herts.*

1916 Ramachandra, Rao Yelseti, M.A., *Agricultural College, Coimbatore, India.*

1914 Ramakrishna, T. V. Ayyar, B.A., F.Z.S., *The Agricultural College, Coimbatore, S. India.*

1920 ‡ Rambousek, Dr. F. G., M.P., vii/1169, *Prague, Czechoslovakia.*

1920 Raymundo, Prof. Benedicto, Director of the Agricultural Society's Museum, 76, *rua Senador Alencar, Rio di Janeiro, Brazil.*

1907 ‡ Rayward, A. L., 1, *Meadhurst, Mead-road, Eastbourne.*

1898 Reuter, Professor Enzio, *Helsingfors, Finland.*

1910 ‡ de Rhé-Philipe, G. W. V., *Birkheads, Reigate, Surrey.*

1921 Rhodes, F., *Corporation Art Gallery and Museum, Cartwright Memorial Hall, Lister Park, Bradford.*

1920 ‡ Rhynehart, John George, A.R.C.Sc.I., N.D.A., *Ministry of Agriculture, Wellington Place, Belfast.*

1924 ‡ Richards, O. W., 70, *Belsize Park Gardens,* N.W. 3.

1920 ‡ Richards, P. B., 7, *Churchways Crescent, Horfield, Bristol.*

1920 ‡ Richardson, Arthur Walter, 28, *Avenue-road, Southall, Middlesex.*

1922 ‡ Richardson, Rev. W. H., 32, *Shirburn-road, Leek, N. Staffs.*

1921 Riddell, Miss J., 815, *N. El Centro Avenue, Los Angeles, California, U.S.A.*

1924 Riley, C. F. C., *Dept. of Zoology, Univ. of Manitoba, Winnipeg, Canada.*

1912 ‡ Riley, N. D. (Council, 1921–23), 5, *Brook Gardens, Beverley-road, Barnes,* S.W. 13, and *British Museum (Natural History), S. Kensington,* S.W. 7.

1908 ‡ Rippon, Claude, M.A., 28, *Springfield House, Abingdon.*

1917 Roberts, A. W. Rymer, M.A., *Molteno Inst., Downing-street, Cambridge.*

1889–1898 ; 1925 :
Robinson, A., B.A., *Bretavely, Seal, nr. Sevenoaks, Kent.*

1905 Robinson, Herbert C., 113, *Prior's House, St. James' Court, Buckingham Gate,* S.W. 1.

1904 ‡ Robinson, Lady, *Worksop Manor, Notts.*

1921 Roebuck, A., *Midland Agricultural and Dairy College, Sutton Bonnington, Loughborough.*

1908 ‡ Rogers, The Rev. Canon K. St. Aubyn, M.A., *Box* 395, *Nairobi, Kenya Colony, British East Africa.*

1922 Rosa, A. F., M.D., 28, *Pitt-street, Edinburgh.*

1907 ‡ Rosenberg, W. F. H., 57, *Haverstock-hill,* N.W. 3.

1888 †‡ Rothschild, The Right Hon. Lord, D.Sc., F.R.S., F.L.S., F.Z.S. (President, 1921–22 ; Vice-President, 1920, 1923 ; Council, 1900, 1919), *Zoological Museum, Tring.*

1890 ‡ Routledge, G. B., *Tarn Lodge, Heads Nook, Carlisle.*

1922 Russell, Frank, *Auldham House, Worksop, Notts.*

1901 Thompson, M. L., 40, *Gosford-street, Middlesbrough.*
1892 Thornley, The Rev. A., M.A., F.L.S., *St. Anael's, Sea View Terrace, St. Ives, Cornwall.*
1907 ‡ Tillyard, R. J., M.A., D.Sc., F.L.S., Chief of the Biological Dept., *Cawthron Inst. of Scientific Research, Nelson, New Zealand,* and *Maitai Lodge, Bridge-street, Nelson, N.Z.*
1920 Tinsley, Joseph, *West of Scotland Agricultural College, Burns-avenue, Kilmarnock.*
1897 ‡ Tomlin, J. R. le B., M.A. (Council 1911–13), 23, *Boscobel-road, St. Leonards-on-Sea.*
1907 ‡ Tonge, Alfred Ernest (Council, 1915–17), *Aincroft, Reigate, Surrey.*
1920 Tonge, Alfred E., *Ashville, Trafford-road, Alderley Edge, Cheshire.*
1914 de la Torre Bueno, J. R., 11, *North Broadway, White Plains, New York, U.S.A.*
1911 ‡ Tower, P. H.
1906 ‡ Tulloch, Col. J. B. G., C.B., C.M.G., *Head Quarters, 4th Division, Colchester.*
1895 ‡ Tunaley, Henry, *Castleton, Searle-road, Farnham.*
1910 Turati, Conte Emilio, 4, *Piazza S. Alessandro, Milan, Italy.*
1898 ‡ Turner, A. J., M.D., *Wickham Terrace, Brisbane, Australia.*
1893 ‡ Turner, Henry Jerome (Librarian, 1921– ; Council, 1910-12), 98, *Drakefell-road, New Cross,* S.E. 14.
1906 ‡ Turner, Rowland E. (Council, 1909–10), *British Museum (Natural History), S. Kensington,* S.W. 7.
1923 ‡ Twidle, A., N.S.A., *The Rowans, Godstone Green, Surrey.*
1915 ‡ Tytler, Maj.-Gen. H. C., C.B., C.M.G., D.S.O., C.I.E., *c/o Grindlay & Co.,* 54, *Parliament-street,* S.W. 1.

1893 ‡ Urich, Frederick William, C.M.Z.S., *Port of Spain, Trinidad, British West Indies.*
1920 ‡ Uvarov, B., *Natural History Museum, S. Kensington,* S.W. 7.

1923 ‡ Valentine, A., *Grand Hotel, Herne Bay, Kent.*
1922 ‡ Van Someren, V. G. L., C.M.Z.S., *Nairobi, Kenya Colony, British East Africa.*
1924 ‡ Van Straubenzee, Brig.-Gen. C. H. Casimir, C.B., C.B.E., 3, *Sussex Mansions, Sussex Place,* S.W.
1904†‡ Vaughan, W., *The Old Rectory, Beckington, Bath.*
1914 ‡ Veitch, Robert, B.Sc., Chief Entomologist, *Dept. of Agriculture, Brisbane, Australia.*
1909 Vidler, Leopold A., *The Carmelite Stone House, Rye.*
1911 Vitalis de Salvaza, R., *chez Mme. G. Combe,* 10, *Rue d'Italie, Marseilles.*
1897 ‡ Wainwright, Colbran J. (Council, 1901, 1912–14), *Daylesford, Handsworth Wood, Birmingham.*
1918 Walford, Lionel Julian, *The Cavalry Club, Piccadilly,* W.

1878 ‡ Walker, James J., M.A., R.N., F.L.S. (President, 1919–20; V.-Pres., 1916, 1921; Sec., 1899, 1905–1918; Council, 1894, 1921), *Aorangi, Lonsdale-road, Summertown, Oxford.*

1921 Walker, S., 53, *Micklegate Hill, York.*

1920 Wallace, William, M.B., 15, *Hainton-avenue, Grimsby.*

1921 Wallis, H. H., M.A., *Rye Grammar School, Rye, Sussex.*

1920 Walters, Owen Huth, *c/o Standard Bank of S. Africa, Port Elizabeth, S. Africa.*

1919 ‡ Ward, James Davis, *Limehurst, Grange-over-Sands, Lancs.*

1910 ‡ Ward, John J., *Natura, Woodland Avenue, Coventry.*

1908 ‡ Warren, B. C. S., 14, *Avenue de l'Eglise Anglaise, Lausanne, Switzerland.*

1901 † Waterhouse, G. A., B.Sc., B.E., *Allowrie, Stanhope-road, Killara, New South Wales, Australia.*

1923 ‡ Waters, E. G. R., M.A., 184, *Woodstock-road, Oxford.*

1914 ‡ Waterston, James, B.D., D.Sc. (Council, 1920–22), *British Museum (Natural History), S. Kensington, S.W. 7.*

1921 Watkinson, The Rev. G. M. A., *Woodfield, Hipperholme, near Halifax.*

1919 ‡ Watson, E. B., *The Entomological Branch, Dept. of Agriculture, Ottawa, Ont., Canada.*

1918 Watson, John Henry, 70, *Ashford-road, Withington, Manchester.*

1914 Watt, Morris N., *St. John's Hill, Wanganui, New Zealand.*

1923 West, Lieut.-Col. R. M., M.D., D.S.O., O.B.E., *Wootton Bridge, Isle of Wight.*

1906 ‡ Wheeler, The Rev. George, M.A., F.Z.S. (Secretary, 1911–21; V.-Pres., 1914; Council, 1921), *Ellesmere, Gratwicke-road, Worthing.*

1910 ‡ White, E. Barton, M.R.C.S., *The Mental Hospital, Fishponds, Bristol.*

1918 White, Ronald Senior, *c/o Chief Medical Officer, Bengal-Nagpur Rly., Kidderpore, Calcutta, India.*

1923 ‡ Whitfield, F. G. S., *Wellcome Tropical Research Laboratories, Khartoum, Sudan.*

1913 †‡ Whitley, Percival N., *Brantwood, Halifax*; and *New College, Oxford.*

1921 ‡ Whitney, W. B., B.Sc., A.M.Inst.C.E., *Glen Doone, Gerrard's Cross, Bucks.*

1913 † Whittaker, Oscar, F.R.M.S., *Box 552, Chilliwack, British Columbia.*

1911–1920; 1925:
Whittingham, Rt. Rev. A. G., Lord Bishop of St. Edmundsbury and Ipswich, *The Bishop's House, Ipswich.*

1917 ‡ Wickham, Rev. Prebendary A. P., *East Brent Vicarage, Highbridge, Somerset.*

1903 ‡ Wiggins, Clare A., C.M.G., M.R.C.S., *The Folly, Watlington, Oxon.*

1923 Wightman, A. J. C., *Aurago, W. Chiltington Common, Pulborough, Sussex.*

1896 ‡ WILEMAN, A. E., 37, *Queen's Gate Gardens, London*, S.W. 7.
1922 ‡ WILKINSON, Capt. D. S., *Board of Agriculture, Nicosia, Cyprus.*
1923 WILKINSON, H., *P.O. Box* 93, *Kampala, Uganda.*
1911 ‡ WILLIAMS, C. B., M.A., *Ministry of Agriculture, Cairo, Egypt*, and 20, *Slatey-road, Birkenhead.*
1915 WILLIAMS, Harold Beck, *Briar Cottage, Vale-road, Claygate, Surrey.*
1921 ‡ WILLMER, E. Nevill, *Trafford Hall, near Chester.*
1922 WILSON, F. E., 22, *Ferncroft Avenue, E. Malvern, Victoria, Australia.*
1921 ‡ WILSON, H. I., O.B.E., M.A., F.Z.S., 139, *Bishop's Mansions, Fulham*, S.W. 6.
1919 † WILSON, Lt.-Col. R. S., *Army and Navy Club, Pall Mall*, S.W.
1925 WINCKWORTH, R., 37, *Upper Rock Gardens, Brighton.*
1915 WINN, Albert F., 32, *Springfield Avenue, Westmount, Montreal, Canada.*
1922 ‡ WINSER, H. E., 2, *Mead-road, Cranleigh, Surrey.*
1923 ‡ WINSTANLEY, E. J., L.D.S., R.C.S., 32, *Belsize-grove, Haverstock Hill*, N.W. 3.
1920 ‡ WITHYCOMBE, C. L., Ph.D., M.Sc., D.I.C., *Imperial College of Tropical Agriculture, Trinidad, B.W.I.*
1919 WOOD, H. Worsley, 31, *Agate-road, Hammersmith*, W. 6.
1905 WOODBRIDGE, F. C., *Briar Close, Latchmore-avenue, Gerrard's Cross S.O., Bucks.*
1925 WOODCOCK, A. J. A., M.Sc., *Clifton Manor, York.*
1914 ‡ WOODFORDE, F. C., B.A., *c/o University Museum, Hope Department, Oxford.*
1925 ‡ WOODWARD, Commdr. G. C., *Training Ship "Cornwall," Purfleet, Essex.*
1921 WOOLETT, G. F. C., *Sipilang, Province Clarke, B.N. Borneo.*
1922 WRIGHT, A. E., *Burnleigh, Kent Bank-road, Grange-over-Sands.*

1925 EL ZOHEIVY, M. Soliman, 5, *Charleville-road, W. Kensington*, W. 14.

ADDITIONS TO THE LIBRARY

During the Year 1925.

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——— Namen Verzeichniss. Ditto (containing the new place names). Leipzig, 1925. *Purchased.*

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Bovie (A.). Catalogue des Anthribides.
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Authors.

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——— Les Moustiques de l'Afrique Mineure de l'Egypte et de la Syrie. 4to., Paris, 1924.

—— — Faune de France: Dipteres Anthomyiides. 4to., Paris, 1923. *Purchased.*

Stephens (J. F.). Illustration of British Entomology. 12 vols. [Curtis' copy with his annotations.] London, 1828–42. *Purchased.*

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SEPARATES FROM PUBLICATIONS AND JOURNALS NOT RECEIVED IN THE LIBRARY.

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Ayyar (T. V. R.). The Nim Mealy Scale (*Pulvinaria maxima*, Green). [Mem. Dept. Agric. India, Entom. Ser., Vol. VIII, No. 12, April.] 1925. *Agric. Res. Inst., Pusa.*

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TRANSACTIONS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

FOR THE YEAR 1925.

I. *On the Abdominal Brushes in certain male Noctuid Moths.*

By H. ELTRINGHAM, M.A., D.Sc., F.Z.S.

[Read March 12th, 1925.]

PLATE I.

THE presence in certain Lepidoptera of brush-like organs peculiar to the male sex is now well known. Fritz Müller (1877–1880) * wrote interesting papers on these and other presumed scent-organs. Illig † described many more in 1902, and the present writer has published histological details of the brushes and glands in Danaine Butterflies,‡ and also of the similar but very minute structures first discovered, in the heads of species of the Neuropterous Genus *Hydroptila*, by Mr. Martin E. Mosely.§

The present occasion seems a favourable opportunity of stating that when the above-quoted papers on Danaine Scent-Organs were written, the writer had not seen Illig's work on the subject, a fact which gives the rather startling similarity of some of the corresponding figures a certain confirmatory value.

The existence of abdominal brushes in noctuid moths seems to have been long known, though I have been unable

* See Supplement to Longstaff's "Butterfly Hunting in Many Lands."

† Duftorgane der männlichen Schmetterlinge, Zoologica, Stuttgart. ‡ Trans. Ent. Soc. 1913, p. 399; 1915, p. 152.

§ *ibid.*, 1919, p. 420.

to find any detailed account of their structure. In Berlese's Gli Insetti, vol. i, p. 557, a reference is given to a paper on the subject by W. Pollack, but there must be some error in the quotation, since I have been unable, even with the assistance of the authorities of the British Museum of Natural History and of the Zoological Society, to trace the article in question. In any case previous references to the subject would seem to be neither numerous nor easily consulted, conditions which afford a sufficient reason for publishing the present account of these interesting organs.

In the "Genitalia of the Noctuidae," by F. N. Pierce (1909), the author calls attention (p. 18) to the "pencils of hair," which "appear to be almost unknown." He points out that owing to their irregular occurrence they are of no generic value, and that they are often found in close proximity to the genital organs, but generally on one of the anterior abdominal segments. He further states that although he has recorded their presence in every species in which he has actually observed them, his failure to notice them in other species is not to be taken as conclusive evidence of their absence.

The species in which the brushes have been observed by this author are some thirty-six in number. As examples for the present account I have taken *Phlogophora meticulosa* and *Xylophasia monoglypha* (formerly *polyodon*).

Careful examination of the underside of the abdomen of a male of either of these moths will reveal an invaginated fold of the cuticle beginning in the first abdominal segment and extending posteriorly for a distance of about six to seven millimetres. This fold is not easily seen, since its external edges are often closely approximated, and further concealed by the cuticular scales which cover the whole abdomen. The point of a pin inserted laterally at the anterior end of the fold and then gently lifted will usually draw the brush out of its hiding place, and although it tends to spring back again to a position parallel with that of the long axis of the body, it does not easily re-enter the groove. Presumably during life the insect can open the fold by muscular action or internal pressure, since only in this way could the brush be replaced.

The brush itself forms a beautiful microscopic object, apparently dark-coloured at the base, very pale towards the middle of its length, and somewhat darker again

distally. This appearance is, however, only partly due to actual pigmentation, the apparently pale band being mainly caused by a marked decrease in the diameter of the hairs over this part of their length.

Fig. 1, Plate I, is a semidiagrammatic representation of the expanded brushes of *P. meticulosa*, the hairs of which are in reality more numerous and delicate than can be accurately expressed in a drawing.

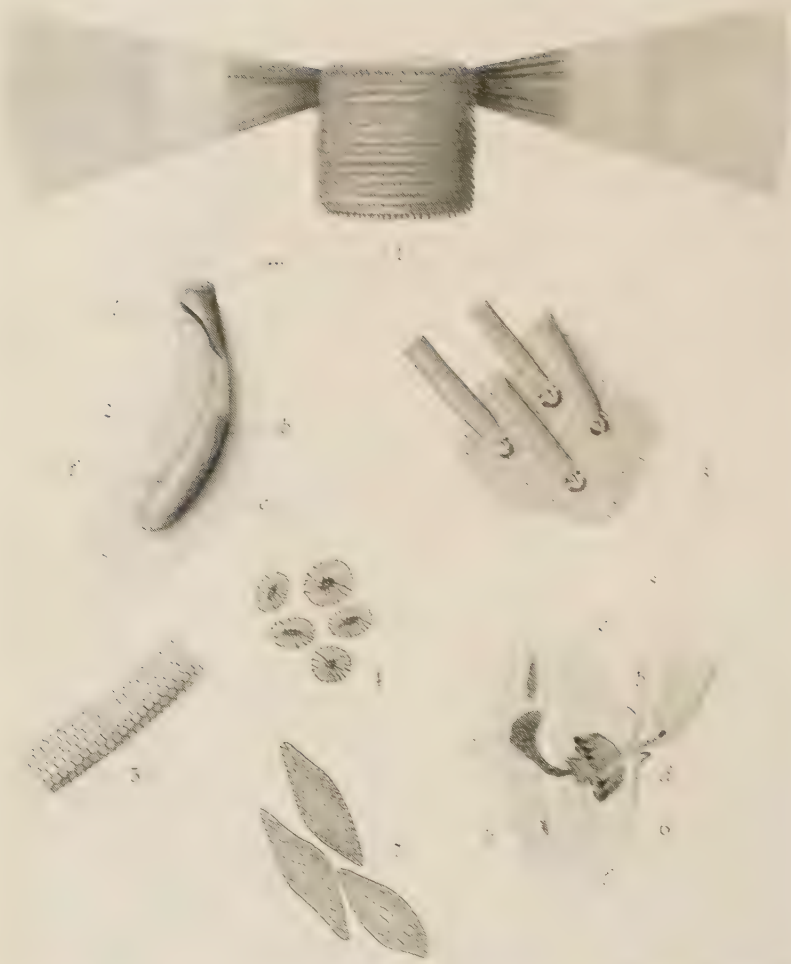
If the anterior part of the abdomen be removed and one of the brush folds with a little of the surrounding cuticle carefully cleaned and examined from the inner side, the appearance is as shown in fig. 2 (taken from *X. monoglypha*). Here the brush *b* can be seen closely contracted and lying within the fold *f*. At *m* is a mass of delicate muscle-fibres connected with the hair-sockets, and *l* is a chitinous structure which with its muscle fibres, not shown in the figure, serves to extend the brush from its groove, and also, doubtless in conjunction with the muscles *m*, to expand the hairs.

The hairs of the brush when examined under a high power vary in appearance according to whether we are looking at the basal, median, or distal portions. At the base they arise from rather elaborate chitinous sockets with the muscle-fibres already mentioned, and are in the form of rather thin-walled tubes of roughly quadrate section, about ·013 mm. from side to side. They continue thus for about a quarter of their length, when they become gradually reduced in diameter to about ·006 mm., and the small lumen is partly blocked with a granular substance. The diameter then increases to about ·016 mm. with a tendency to flattening distally. In this part the hairs are almost solid. Transverse sections have the appearance shown in fig. 4, in which the irregular, more or less radiate lines represent parts of the structure which stain deeply in haematoxylin. In surface view the hairs appear as represented in fig. 5. The design is a roughly hexagonal pattern, rather suggestive of a roll of wire-netting. The lines forming the hexagons are very slightly raised. All these features are much alike in both *monoglypha* and *meticulosa*. If we now turn our attention to the fold or groove of the cuticle in which the brush normally lies, we find that it is thickly lined with large scales. Fig. 3 (*monoglypha*) shows a small piece of this lining. For the sake of clearness I have only shown four

scales, but they are relatively more closely placed over the greater part of the surface. In section they have the appearance shown in fig. 7. They are almost solid with a mere trace of a central lumen, and even in this there is a slightly staining substance, indicating the presence of at least a congealed secretion. The surface of the scales is very faintly ribbed, and the inner substance shows little structure beyond a slight reticulation.

In the absence of any better explanation we must assume these brush-organs to constitute a scent-producing and distributing apparatus, and it is probably safe to regard the scales as the producers and the brushes as the distributors. We should therefore expect to discover a well-developed series of glands in connection with the scent-scales. In Danaine butterflies the glands are in most cases very highly developed; indeed they cause, in those species in which they are situated in the hind-wing, a remarkable thickening of the appropriate wing-area. Such a special glandular development is not evident in the species here described, nor was it found in others examined for the present purpose. Such glands as do exist are rather more easily seen in *meticulosa* than in *monoglypha*, and fig. 6 shows as much of their structure as I have been able to make out. The scale *s*, a flatter, more markedly ribbed, and rather less spongy structure than in *monoglypha*, is inserted in a socket of the cuticle *c*, and beneath the socket is a more or less dome-shaped structure *d*, which takes a fairly dark stain (saffranin), and shows attached to it small masses of a still darker staining material. Within this dome there appears to be a funnel-like tube of chitin, distally more or less continuous with the insertion of the scale-stalk. From the proximal and wider end of this funnel arises a pyriform body *g*, taking a deep stain and mainly embedded in the thin layer of hypoderm *h*. This pyriform body is the most characteristic and easily recognised of all the features associated with these scale attachments. Within the stalk of the scale are generally to be seen dark-staining particles *b*, which suggest a congealed secretion.

The whole apparatus is so small in comparison with the mass of scales and the large brushes, as to appear out of proportion, and inadequate to its assumed function. It may be helpful, however, here to recall the fact, discovered in connection with the scent-apparatus in the Danainae,



NOCTUID SCENT-ORGANS.

that where the scent-patch of the wing is replaced by a pocket, and the secretion thus better protected and conserved, the activity of the scent-producing glands, and especially of those producing the "dust," though these are not present in the moths here described, is much reduced in the imaginal state, being at its highest activity in the nearly mature pupa. This may possibly be the case in these noctuid moths. I have not yet had an opportunity of making sections from a pupa, but we may find that the apparently inadequate glandular equipment is due to a decrease of secretional activity in the imago.

So far as I am aware no actual observation of the functional activity of these brushes has been made. Probably they are never expanded except in flight, and perhaps only then in the immediate presence of a female. With so common a species as *monoglypha* it should not be impossible to devise some experiment calculated to reveal their mode of employment. Meanwhile it is perhaps of some interest to record the existence of a little-known organ in insects which are among our commonest and most familiar species.

Explanation of Plate I.

Fig. 1. First three segments of abdomen of *Phlogophora meticulosa* with brushes expanded.

2. Part of lateral cuticle of abdomen (*X. monoglypha*), with contracted brush lying in fold and viewed from inner side. *b*. Brush in fold. *c*. Cuticle. *f*. Part of cuticular fold. *l*. Chitinous lever. *m*. Mass of muscle fibres.

3. Portion of cuticle of fold, showing lining of large scales (*monoglypha*).

4. Transverse sections of brush hairs.

5. Surface view of part of a brush hair.

6. Section through scale socket (*meticulosa*). *b*. Darkly staining particles in scale stalk. *c*. Cuticle. *d*. Dome-like structure round scale stalk. *g*. Glandular cell. *f*. Funnel-shaped interior of scale-socket. *h*. Hypoderm. *s*. Part of scale.

7. Sections of scales (*monoglypha*).

Note.—The magnifications vary. The actual length of brush is about 6 mm. Greatest diam. of a hair ·0156 mm. Smallest ditto about ·002 mm.

II. *On a new Organ in certain Lepidoptera.* By H. Eltringham, M.A., D.Sc., F.Z.S.

[Read March 12th, 1925.]

Plate II.

Some time ago my friend Dr. K. Jordan called my attention to the presence, in certain Lepidoptera, of what appeared to be a previously undescribed sense-organ. In a short paper in Novit. Zool. 1923, pp. 155–158, pl. 2, he has described its external features and named it Chaetosoma. It occurs in many families and varies a great deal in size and outward appearance. In Geometridae and Uraniidae it consists externally of two small patches of unscaled chitin situated on the top of the head behind the antennae and at the junctions of the inner margins of the eyes with the central part of the head. Under a low power the surface is seen to be provided with a few very fine bristles or hairs. In most cases the Chaetosoma is so small, and the neighbouring tissues so heavily chitinised, that it is a matter of great difficulty to cut sections in which the histology of the structure can be recognised. In certain Uraniid moths it is more highly developed, and I am indebted to my friend Dr. C. L. Withycombe of the Department of Agriculture, Trinidad, for an example of *Sematura empedocles* Cram. which he kindly sent me, preserved in a manner suitable for subsequent microscopical examination.

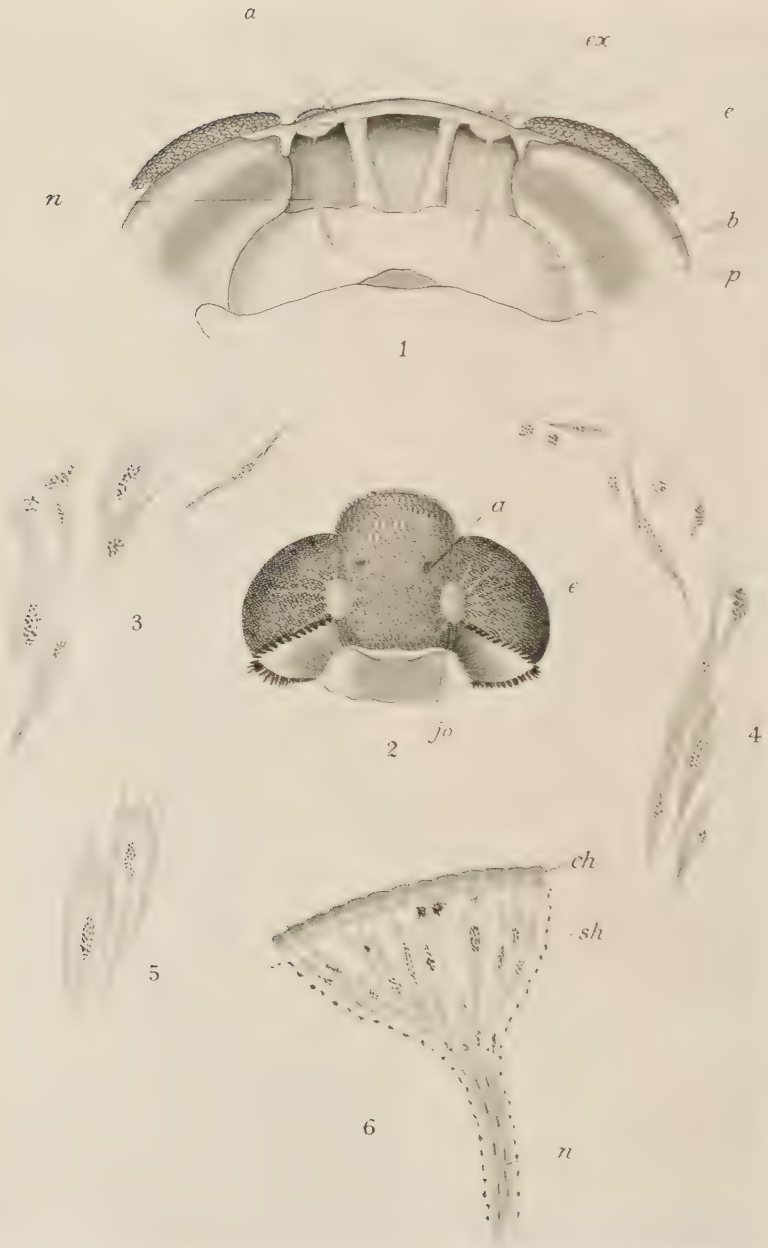
A single specimen is not sufficient for exhaustive study, and I have been unable to make as complete an investigation as I hope ultimately to accomplish, but enough has been done to make it worth while to publish the results in the form of a preliminary account and "without prejudice."

On removing the head of the moth and clearing away the chitin at the back, one can see the structures represented semidiagrammatically in fig. 1, Plate II. In this figure, *e* is a portion of the eye, *p* its posterior chitinous envelope, *b* the brain, and *a* the antennal nerve cords. The external part of Jordan's organ is at *ex*, and at *n* is the nerve which arises from the back of the brain and enters the organ.

Fig. 2 represents the head viewed from above, where *e* is the eye, *a* the position of the attachment of the antennae,

and *jo* the organ now described. Paucity of material necessitated careful consideration of its use. Having cut the head in two, the nerve with its subcuticular expansion was carefully removed from one side, the chitinous area mounted for surface examination, and the nerve, etc., embedded and cut into sections in the plane of its long axis.

The organ on the other side was embedded whole, *i.e.* with chitin and nervous connections together, and an attempt made to obtain sections which would show the relationship between the nerve endings and the chitinous external surface. The attempt was not very successful. The stain (haematoxylin) cannot be differentiated in the chitin before it is entirely removed from the nerve tissue, and the process of preservation and cutting causes the nerve substances to break away from the cuticle. The longitudinal sections of the nerve and its peripheral expansion were, however, more successful, the nerve being cut six or seven times through its whole length, and the organ itself providing a much larger number of sections. Figs. 3, 4, and 5 are drawn from actual sections and show that the commonest type of nerve-ending is an elongated bipolar cell having a large and heavily granulated nucleus, though there are other cells present which appear to consist of a sheath of delicate longitudinally striated nervous tissue enclosing a more or less pyriform, heavily nucleated cell. The nerve itself which connects the organ with the brain is of the usual type, showing a fibrous cord with elongated nuclei, the whole enclosed in a heavily nucleated sheath, the latter resembling the sheath structure described by me as enveloping the tympanic nerve cord in *Chrysiridia ripheus* (Trans. Ent. Soc. 1924, p. 443 *et seq.*). The chitin of the external surface of the organ does not show, so far as I have been able to discover at present, any special modification. The outer layers retain haematoxylin longer than the inner portions, the exterior surface has many very minute projections, and a slightly laminated structure is apparent, together with traces of transverse pores. The large bristles have the usual sockets, and appear to be tubular with a slightly fluted surface. Direct nerve connections to the bristles were not found, though there is some evidence that they do in fact exist. Examination under a very high power of a series of sections gives one the accumulated impression of a structure



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THE CHAETOSOMA IN SEMATURA.

diagrammatically represented in fig. 6, where *ch* is the chitinous surface, *sh* the sheath membrane, and *n* the main nerve. The nerve-endings do not exhibit any peculiar structure which would assist in forming a theory of their function. The peculiar bodies known as scolopales (see *l.c. supra*) are not present, and as these have always been found in organs which suggest an auditory function, we may perhaps exclude that explanation. Nerve-endings similar to those here described may be found in connection with some larval spines (see Berlese, Gli Insetti, vol. i, p. 611), also in antennae of Coleoptera (*l.c.* p. 623, fig. 751). Whilst the structure of many insect organs is known, their function remains obscure and insect neurology is not yet in a very advanced stage. The antennae, and, from the recent work of Minnich, in some cases the feet, are probably the seat of an olfactory sense, and we should scarcely expect a supplementary olfactory organ in this position. Tactile sensibility is probably distributed over the whole body. The Chaetosoma may serve some purpose which, for lack of personal experience, we find it difficult to define. It may even have some static or barometric function.

The subject offers, to those favourably situated for the study of species in which the organ is highly developed, an opportunity for interesting experiments.

Explanation of Plate II.

Fig. 1. Back of head of the moth, *Sematura empedocles* with chitin removed. *a*. Antennal nerves. *b*. Brain. *e*. Part of compound eye. *ex*. The chaetosoma. *n*. Nerve to ditto. *p*. Posterior chitinous envelope of eye.

2. Dorsal view of same less magnified. *a*. Position of attachment of antenna. *e*. Compound eye. *jo*. Jordan's Organ or chaetosoma.

3, 4, 5. Various sections through the nerve endings.

6. Reconstructed section of chaetosoma. *ch*. The outer chitin. *sh*. Nerve sheath. *n*. Nerve cord.

The magnifications vary, but the diameter of the nerve cord *n* fig. 6 is ·0156 mm.

III. *On the Source of the Sphragidal Fluid in* Parnassius apollo (Lepidoptera). By H. Eltringham, M.A., D.Sc., F.Z.S.

[Read March 12th, 1925.]

Plate III.

The existence of a peculiar structure on the abdomen of the female *Parnassius*, after pairing, has long been known. Indeed it would almost seem that more has been written about it, and with less result, than about most features of insect structure. F. Bryk, in a paper communicated to Arkiv for Zoologi, 11, No. 18, p. 7 *et seq.*, 1918, by Prof. Aurivillius, gives a bibliography which includes no less than ninety references extending from Linnaeus in 1745 to Fischer in 1916, and even this is not complete, since he appears to have omitted the rather surprising contribution to the subject published by the late M. Ch. Oberthür and Prof. Houlbert (Etudes 11, 1916) and my reply thereto (Trans. Ent. Soc. 1916, p. 289). Bryk entitles his paper "Grundzuge der Sphragidologie," thus adopting the word "Sphragis" suggested in my monograph of the Genus *Acraea* (Trans. Ent. Soc. 1912, Pt. I). Apparently Siebold (Zeit. Wiss. Zool. V, 3, p. 53, 1851) was the first to recognise that the sphragis was not a part of the female insect, though the non-acceptance of his views in spite of repeated confirmation has long persisted, even down to recent years (see Houlbert, *l.c.* 1916). As to the function of the sphragis, Bryk states that Marshall (Entomologist, p. 74, 1901) "seems to have come nearest the truth as he supposed that the sphragis served to protect the impregnated females from other males." It would appear that this explanation came in the first instance from Professor Poulton, for in a letter received by him from Dr. Marshall, and dated May 14, 1897, there occur the words "I therefore rather incline to your second suggestion, that it is probably to prevent copulation a second time." Bryk claims to have arrived at the same conclusion independently "through detailed study of the morphological structure of the sphragis."

There has been much controversy as to which sex

supplied the fluid which forms this peculiar attachment, Karsch, Verity, and others maintaining that it is the female, Thiele and Bryk that it is the male. Bryk, having remarked that no one has yet discovered the structure of the glands which secrete the plastic material, proceeds to give suggestions as to the lines on which research in "Sphragidology" should be conducted.

A good review of early work on the subject will be found in the article by the late H. J. Elwes in Proc. Zool. Soc. 1886, p. 6 *et seq.* From this it would appear that Siebold first pointed out that the sphragis is not, as many have supposed, a chitinous structure, but that it dissolves, when treated with caustic soda, leaving only brown oily drops. Mr. Elwes obtained pupae of *P. apollo* which he placed in the care of Mr. A. Thomson at the Insect House of the Zoological Society. Mr. Thomson observed the pairing of the species and furnished an account of it, the details of which will be found in the paper above quoted. From this we may select the following observations. The sphragis is developed entirely during copulation. It has nothing to do with oviposition, since in one case a female laid an egg while actually paired. The sphragis is at first in a plastic condition and will retain impressions made upon it by external contact. A fluid resembling that used in its formation can be expressed from the male abdomen, such fluid hardening rapidly on exposure to the air.

From these and similar observations we may, I think, safely conclude that the material is furnished by the male. Since the quantity is very large in comparison with the size of the insect's body, the glands which produce it should be of macroscopic dimensions, and easily discovered.

From my own researches in *Heliconius*, and those of my friend Mr. G. T. Bethune-Baker and myself on certain moths of the Genus *Rhodogastria*, we know that large glands actually situated in the male claspers do, in some cases, exist. These, however, are associated with attractive or repulsive scents, and in any case are not found in species of *Parnassius*, nor, so far as I am aware, in other genera in which a sphragis is formed. No large independent glands can be discovered in the abdomen of *Parnassius*, and we are left with the alternative of examining the detailed structure of the internal male sexual organs.

Through the kindness of my friend Dr. K. Jordan, who sent me living material taken by him when on a visit to

Switzerland, I have been enabled to make such an examination. The structure of the internal male organs in Lepidoptera, though described, seems not to be a matter of common knowledge amongst Lepidopterists, and I would therefore refer the reader to fig. 1 on Plate III, which is drawn from a complete dissection of these parts in the male *P. apollo*. The aedeagus is shown at *a*, and from it there passes a single tube, the ejaculatory duct, which ultimately joins a pair of organs *v*, which are probably vesiculae seminales. With these are laterally connected the vasa deferentia or ducts from the testes *tt*. Such diagrams as I have seen of the internal male organs of Lepidoptera always show the two testes enclosed in a common capsule, and from my own dissections I am able to affirm that they are so enclosed in Sphingid moths and Danaine butterflies. To what extent this arrangement predominates I am unable to say, but in *Parnassius apollo* the testes are undoubtedly quite separate and independent. Now it might be supposed that the testes with their ducts, and the vesiculae seminales, would constitute the greater part of the internal male organs, but whilst they are doubtless of first importance functionally, they are of quite secondary consideration in the matter of size, for opening direct into the vesiculae seminales are two very long, much convoluted glandular tubes *ac*, *ac*, which in the fresh insect occupy a large part of the abdominal cavity. They consist of a comparatively thin-walled glandular epithelium and are filled with a copious secretion. This fluid when freshly removed is slightly viscous and of a faintly milky appearance. If portions of a gland be teased out on a slide and exposed to the air, the fluid rapidly hardens. In spirit specimens the glands remain soft, and are very easily torn or broken; indeed it would scarcely be possible to make a dissection such as that shown in the figure, from a preserved specimen. If a portion of this gland which has been in spirit be allowed to dry it becomes hard and very brittle.

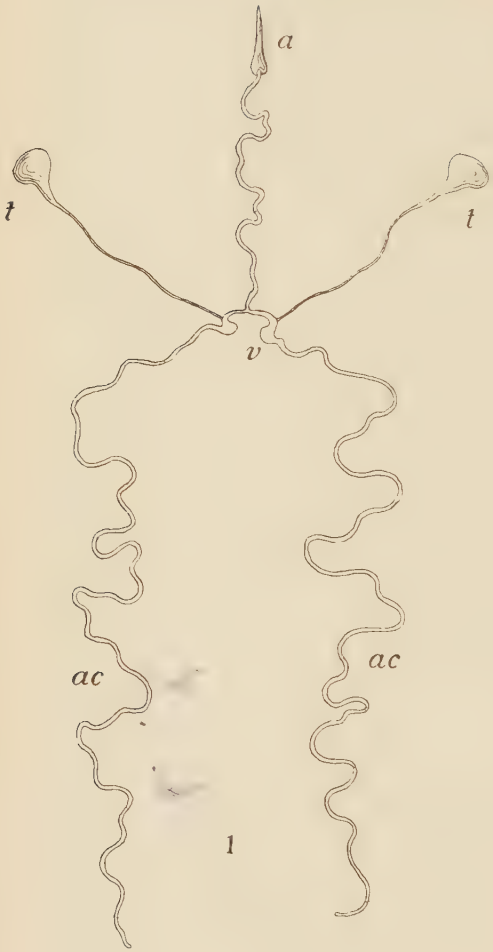
Now if the secretion of these glands is quantitatively proportionate to their size, and is discharged in the process of pairing, it would fully account for the material of the sphragis, more especially as observers agree that the insects normally remain paired for a long time, varying from some hours to over two days. We need scarcely, I think, look further for the origin of the sphragidal fluid.

It may be objected that these accessory glands are, so far as we know, found in all male Lepidoptera, whereas the sphragis is by no means a universal development. I have not up to the present dissected a sufficiently representative series of examples to enable me to judge of their comparative development. They are large and conspicuous in *Amauris niavius*, an African Danaine butterfly, but the sphragis is found in this genus. They occur in a Sphingid moth (*S. populi*), though less developed, and here no sphragis is found. The same remarks apply to a Noctuid moth, *Polia chi*. Subject to the results of further dissections it would seem that the accessory glands are at least more highly developed in the species which produce this curious female appendage, and in *Parnassius* we know that this development is accompanied by a prolonged pairing period which would afford an opportunity for a continuous secretory activity.

As regards the histology of the gland itself, I regret that I was unable to prepare sections until some time after the available material had been preserved, and possibly there may have been some deterioration of the tissues. Figs. 2, 3, 4, represent sections of parts of the gland in *P. apollo*, which show that it consists of a delicate sheath membrane *sh* (fig. 2), lined with a glandular epithelium *gl*, of heavily nucleated cells. These cells vary in thickness in different sections (see fig. 4), such variation being doubtless proportionate to the degree of exhaustion of their secretory activity.

Fig. 3 shows an appearance common to many sections where the lumen of the gland is heavily charged with the secretion. It would appear that in such positions the gland cells actually break down and discharge their entire contents.

Probably the normal use of the gland is to provide a vehicle for the carriage of the spermatozoa, but in certain genera its functional activity is increased, and the excess of fluid produced forms the sphragis.



H. Eltringham del. *Vaus & Crampton, Ltd.*

INTERNAL SEXUAL ORGANS OF MALE PARNASSIUS APOLLO.

Explanation of Plate III.

Fig. 1. Complete dissection of internal male sexual organs of *Parnassius apollo*. *a*. Aedeagus. *ac*. Accessory glands. *tt*. Testes. *v*. Vesiculae seminales.

2. Section of part of accessory gland. *gl*. Gland cells. *sh*. Epithelial sheath membrane.

3. Ditto from another part of gland showing cells disintegrating.

4. Ditto from another part of gland showing less active cells.

Actual length of accessory gland is about 70 mm.

IV. *The* Rhopalocera *and* Grypocera *of Palestine and Transjordania.* By P. P. Graves, F.E.S.

[Read December 3rd, 1924.]

Plates IV, V.

Introduction.

During the last two years of the war and again in 1921 and 1922 I was able to collect at times in various parts of Palestine. In 1923 I received a considerable collection of Rhopalocera and Grypocera for examination, the fruits of three years' collecting by Dr. P. A. Buxton, who asked me to publish an account of this collection. Subsequently, through the kindness of Capt. N. D. Riley, I had the opportunity of studying a collection made by Mr. H. St. J. Philby, C.I.E., while acting as representative of the High Commissioner for Palestine in Transjordania. More lately I have seen an interesting collection of Palestinian butterflies in the possession of Capt. A. F. Hemming, and others made during and since the war in Palestine by Capt. P. Barraud and Mr. V. Bell, and now in the Hope Museum at Oxford. With these collections and a number of papers by various collectors, British and Continental, to study I decided to undertake the following account of the Rhopalocera and Grypocera of Palestine and Transjordania.

While Palestine has been more thoroughly explored than many other parts of the Near and Middle East, much remains to be done. The Beersheba region, the mountainous country to the S. and S.W. of the Dead Sea, parts of the Jordan Valley and of the Judaean and Galilean Plateaux are practically unexplored. In Transjordania, or as it is now officially styled "The Transjordan," Mr. Philby, though prevented by his official duties from devoting much time to collecting, discovered four new subspecies of Rhopalocera which are hereinafter described. I should like to acknowledge my indebtedness to the entomologists already mentioned for much help and advice, also to Professor Poulton, Mr. E. Adair, F.E.S., of the Ministry of Agriculture, Cairo, M. Culot, and Professor H. Rebel of the National Natural History Museum of Vienna, whose studies of the Near Eastern Lepidopterous Fauna have been most valuable to me, and who has been kind enough to identify some of the Transjordanian Melitaeas.

PART I.

Faunistic.

1. *Geographical Introduction.*

For geographical purposes Palestine is merely a southern extension of Syria, but while its flora and fauna are generally speaking Syrian, *i.e.* a mixture of Northern (Siberian) Palaearctic, Mediterranean and Steppe elements, the last two being in many instances not easily distinguishable from one another and together forming a still larger proportion of the species than is the case in Asia Minor or the Balkan Peninsula, they present certain peculiar features of interest. These are, firstly, the absence of a number both of Siberian and of "Pontic" or "East Mediterranean" species which occur in the more northern parts of the Near East and in the higher parts of Syria proper, and, secondly, the presence of a number of tropical species, mostly of Ethiopian affinities or origin, some of which are practically confined to that remarkable geographical feature the Jordan Valley, while others may first have entered the country from it and are now widely distributed on the lower ground.

The political frontiers of mandatory Palestine include Banias, which is probably an extension of the Lebanon-Hermon sub-district of the Syrian district of the Mediterranean sub-region, and do not include most of the eastern bank of the Jordan Valley. The political border between Palestine and Egypt represents, near the Mediterranean, a faunistic border between a really desert dune region and the "veldt" or steppe of S. Palestine, but further to the S.E. towards Aqaba it passes through rocky mountainous country still a *terra incognita* to the naturalist. In this paper the Jordan Valley, whether to E. or to W. of the river, is regarded as faunistically a part of Palestine, and the term "Transjordania" is applied to the country S. of the French mandatory area in Syria and E. of the 500-ft. contour to the E. of the River Jordan, and of the Dead Sea as far south as Maan and as far east as the oasis of Azraq.

Zoogeographically Palestine falls into three main divisions, the Coastal Plain, the Plateaux and the Jordan Valley or Rift. The Plain commences near Akka, and towards Haifa spreads inland in the great plain generally known as the Plain of Esdraelon which links up with the

Rift in the Beisan region. At the extremity of Mt. Carmel the Plain is reduced to about 200 yards in width, but thereafter it gradually expands. Its central portion between the Nahr Zarqa or Crocodile River near Athlit and Jaffa is usually known as the Plain of Sharon. At Gaza the Coastal Plain is about 20 miles in breadth. A line of sand-dunes divides it from the sea. A few perennial streams and a large number of "Wadis," *i.e.* channels, often deeply cut in the alluvial plain, which carry flood water from the Plateaux in the rainy season, traverse it from east to west. Near the coast are some large marshes, notably those near Athlit, where the crocodile may survive, which would be more attractive to the naturalist were they less malarious. But most of the Plain as far as Gaza is well cultivated and closely settled, especially the Plain of Sharon, where garden and orchard cultivation are general. South of Gaza the decrease of the rainfall produces steppe conditions, and except at such oases as Khan Yunus the southern steppe is largely given over to pasture in unfavourable years.

Trees other than cultivated species are by no means frequent on the Coastal Plain. The old forest has disappeared; tamarisk, various willows and alders are to be found in the marshy areas; in the southern steppe occasional bushes of *Zizyphus lotus* or *Z. spina-christi* break the monotony of the veldt. Beside the fruit trees, almond, pomegranate, orange and fig, and the date palms which are to be found near Gaza, plantations of *Eucalyptus* grow near many of the Jewish settlements; the sycamore fig (*Ficus sycamorus*) is a shade-tree in the villages, and the Acacias, notably *Acacia farnesiana*, an introduced species, are extensively used as hedges in parts of the Plain, while in others the prickly pear flourishes, especially about Gaza, and when unchecked spreads rapidly. Vines are cultivated in many places. The fields in spring teem, unless exceptionally well tended, with Cruciferous weeds, *Sinapis*, *Brassica*, *Eruca*, etc., and fallow or waste land in summer is full of thorny Compositae, thistles, wild artichoke (*Cynara*), *Centaurea*, etc. In the southern steppe bulbous plants, *e.g.* crocus and wild garlic, are frequent after the rains with various species of *Reseda* and many Labiatae and Compositae. These soon die down, and by the end of May the Plain is burnt yellow, except in the neighbourhood of perennial springs or streams or where well-irrigation is

practised. In general the flora is Mediterranean with an increasing proportion of steppe and tropical forms towards the south.

The Plateaux are divided into two main sections by the Plain of Esdraelon. North of the Plain are the uplands of Galilee, which are geographically simply the southern foothills of the Lebanon. Their highest point is Jebel Jermaq near Safed (3,934 ft.). The Plateau of Samaria and Judaea, which slopes down to the steppe to the south, except south-east of Beersheba, where it is continued southwards in a broken chain of mountain country which links up with the Plateau of the Central Sinai to the north of Aqaba (Akaba), does not exceed 3,100 ft. at Mt. Ebal near Samaria. In shape it may be compared to the Italian Peninsula reversed: its spur, Mt. Carmel, the "toe" of the "boot," pointing north-west, while Bruttium points south-west. It falls much more steeply to the east into the Jordan Rift than to the west, where the foothills (the Shephelah of the Hebrews) form a zone several miles wide in many places, botanically intermediate between the Plain and the Plateau. Its surface is generally extremely stony, especially near Jerusalem, where the landscape at first sight appears a waste of boulders. The valleys (Wadis) which arise on the Plateau are generally steep ravines, their sides sometimes mere screes of loose stone, descending to the bed of a watercourse, which may be in flood for two or three days at a time in winter and dry except for an occasional pool in the same week. Sometimes these slopes are overgrown with scrub or terraced by the inhabitants and planted with vines and fruit trees. The few pockets of good land are cultivated, and thin crops of corn interspersed with flowers and weeds may be discovered in the most unlikely situations.

Springs are local. Nablus is well supplied, while Jerusalem, till after the British conquest, depended on cisterns for its water supply in summer. In general the eastern slope of the Plateau, owing to its steeper fall, as well as to the diminution of the rainfall, is ill-supplied with water. There are few springs in the wilderness to the E. of Jerusalem, where the Wadi Kelt, a Palestinian example of an American canyon, alone of all the watercourses carries water for more than a few weeks in the rainy season. On the other hand, the dews are usually heavy on the Plateau and vegetation remains fresh until June at many points, while Mt. Carmel, where the rainfall is heavier than in almost

any other part of Palestine and where the sea breezes temper the summer heat, remains fresh and green in places throughout the summer, though its highest point (1,838 ft.) is about 600 ft. lower than Jerusalem.

The vegetation of the Plateaux is Mediterranean in type, with a considerable proportion of endemic species and a mixture of steppe forms, which is naturally more marked in the south of Judaea and on the eastern slopes. *Cyclamen*, various species of *Anemone*, *Scilla*, *Iris*, and a multitude of Cruciferæ and Papilionaceous plants are particularly characteristic of the Plateau. Trees of any size are infrequent except on Mt. Carmel and in a few localities in Galilee. The sycamore does not thrive on the higher ground, but the mulberry, fig, olive and vine are cultivated, and here and there Terebinths, Carobs, scrub-oak (*Quercus pseudo-coccifera*), *Rhamnus* and *Crataegus* and the usual Mediterranean evergreens, *Arbutus*, *Daphne*, etc., form a thin scrub or "maquis" seldom or never as thick as in the Southern Balkans, Crete, or Southern Asia Minor. Mt. Carmel has a somewhat peculiar vegetation characterised by the relative abundance of *Pinus halepensis*, *Arbutus*, *Styrax*, *Laurus*, *Cercis*, *Viburnum* and *Lentiscus* and the presence of *Quercus sessiliflora* (which is still more frequent on the Plateau of Galilee) among the trees and larger shrubs and the abundance of *Poterium* and *Cistus*. It is the only part of Palestine which makes any pretence to be wooded, and Jewish colonisation has here been marked by considerable reafforestation.

The Jordan Valley, also known as the "Ghor," is the most extraordinary geographical feature of Palestine. It is a depression, apparently caused not by erosion but by the sinking of the earth's surface between two parallel faults for about 120 miles, from Lake Huleh, which is slightly below sea-level, to its lowest point, the Dead Sea, nearly 1,300 ft. below sea-level, south of which the ridge across the Wadi Araba rising to 700 ft. above sea-level cuts it off from the Gulf of Aqaba and the Red Sea, themselves apparently prolongations of the Rift Valley of East Africa. The Rift contains practically the whole course of the River Jordan and its three lakes, the marshy Huleh, the Sea of Galilee with its remarkable fish fauna, and the lifeless Dead Sea. The breadth of the Rift varies greatly. At the junction of the Yarmuk River it is four miles; it expands at Beisan, shrinks further south to expand again and finally

to attain a width of nearly fifteen miles at Jericho. The Dead Sea fills the entire Rift at many points, washing the feet of cliffs and mountain sides, which render it impossible to follow the shore for miles at a time. To the south of it is a marshy area, after which the levels rise gradually to the Wadi Araba ridge.

The flora of the Rift, in which I include the lower valleys and defiles draining into it, differs very markedly from that of the Plateaux and the coast. Many of the characteristic species of these two areas are entirely absent. Thus, while there are over 50 species of *Trifolium* in Palestine, none occurs in the Lower Valley of the Jordan according to Canon Tristram (" Fauna and Flora of Palestine," Preface, p. xv). On the other hand, there is a very large Ethiopian element in the flora, especially in the ravines, which debouch into the Dead Sea and in the Zor or " thicket," *i.e.* the jungle-filled valley of the Jordan itself, a narrow rift within the Rift Valley, which in the Jericho district is generally from 300 to 600 ft. above the level of the river.

At Jericho itself the vegetation is distinctly Nubian in appearance near the Wadi Kelt stream and in the oasis which contains the village, but the considerable expanse of steppe country burnt dry by late April, both above and below the town, has a very mixed flora which in the early spring appears to contain a very large proportion of flowering Crucifers, e.g. *Sinapis*, *Brassica*, *Iberis*, etc. The Dom palm, the huge milkweed (*Calotropis procera*), the mustard tree (*Salvadora persica*), various species of *Acacia* and *Zizyphus*, the Ban (*Moringa aptera*), mingle with tamarisks, willows, sycamore and oleander. The proportion of plants of Ethiopian origin is extremely high in certain localities. Tristram (*loc. cit.*, pp. xiv, xv) remarks that out of over 160 species of plants collected in the Wadi Zuweirat at the S.W. extremity of the Dead Sea only 27 were indubitably European–Mediterranean species. It is therefore not surprising that the fauna of the Jordan Valley should contain so large a proportion of non-Palaearctic elements.

The climatic conditions vary as much as the topography of Palestine. The Coastal Plain enjoys a warm Mediterranean climate. Its mean summer temperature falls slightly from south to north. The winter is mild, the rainfall being heaviest in the north, though it never reaches the figures recorded from Beirut. The hot south wind, often

accompanied by dust storms, blows for from two to four days at a time, both here and on the Plateau, from late March to May and again in October. The west and south-west winds are associated with rain in the winter and spring. In summer north-west winds temper the heat.

The climate of the Plateaux is more extreme. Quite sharp frosts are frequent at night on the more exposed heights; the rainfall is somewhat heavier than in the greater part of the Plain, and heavy showers occur both later (in April) and earlier (in October) than is usual on the coast. Snow occasionally falls heavily above 2,000 ft. More than one heavy snowstorm has been recorded from Jerusalem since 1914. But both in Plain and on Plateau the autumn is longer and far warmer than the spring, no marked fall of temperature occurring before November, and there is little cloud during the greater part of the hot season. The climate of the Jordan Rift and the lower parts of the gorges issuing into it is warm in winter and early spring, when there is in most years a fair rainfall and sometimes much cloud, and literally torrid in summer from April to November, during which period the sky is cloudless for weeks at a time; there is less precipitation than elsewhere in Palestine and intense evaporation. Storms of wind are not infrequent in the Jordan Valley.

The following records of temperatures at Beirut, Haifa and Jaffa in the Northern and Southern Coastal Plain respectively, at Jerusalem and Nazareth on the Plateau, and at three stations in the Jordan Valley, one of which, Mahadet Hajle, is in the Zor and less than 200 ft. above the level of the Dead Sea, are instructive.

Mean Temperature (Fahr.).

Station.	Jan.	April.	July.	Oct.	Annual
Beirut . . .	55·6	64·8	80·4	75·0	68·8
Haifa . . .	54·0	65·8	79·9	75·0	68·5
Jaffa . . .	55·3	64·6	77·6	72·0	67·5
Nazareth (1,200 ft.)	49·3	62·8	77·9	75·0	65·8
Jerusalem (*circ.* 2,450 ft.) . .	45·5	59·0	73·2	67·5	61·2
Tiberias (—653 ft.) .	55·8	69·2	87·3	79·6	73·3
Jericho (—879 ft.) .	54·1	64·9	85·1	?	?
M. Hajle (—1,100 ft. approx.) . .	67·3	77·4	94·5	88·7	82·4

Mean Daily Maxima and Minima (Fahr.).

	Jan.	April.	July.	Oct.	Annual
Jaffa (min.) . .	46·8	54·3	68·1	61·5	57·8
„ (max.) . .	63·9	74·8	87·1	82·6	77·2
Jerusalem (min.) .	38·7	51·1	64·6	59·5	53·1
„ (max.) .	50·7	70·5	86·5	79·9	71·8
Tiberias (min.) .	47·2	57·3	74·4	68·6	62·7
„ (max.) .	64·5	80·7	100·3	90·6	84·0
M. Hajle (min.) .	48·4	60·1	77·0	70·9	64·3
„ (max.) .	86·2	94·8	112·1	106·5	100·5

In most years half the total rainfall is recorded in December and January. The average maximum number of rainy days per month is 13 at Haifa in January, and 12 in the same month at Jerusalem and Tabgha near Tiberias. The following figures are interesting.

Mean Rainfall in Inches.

	1st Quarter.	2nd Quarter.	3rd Quarter.	4th Quarter.	Total.
Haifa . .	13·11	1·53	0·08	12·25	27·97
Jaffa . .	12·18	1·02	0·02	6·19	19·41
Jerusalem .	15·59	1·82	0·04	8·58	26·03
Tiberias .	10·51	1·24	0·00	8·47	20·22

The geological features of Palestine are fairly well known. The Coastal Plain is alluvial, with recent (late Pleistocene) deposits on the coast. The strata of the Judaean Plateau are, first and lowest, hard Cenomanian limestone, overlaid by hard Turonian limestone, and, superimposed on this, soft porous Senonian limestone (Upper Chalk). There are some patches of Eocene limestone in Samaria. The Cenomanian and Turonian limestones form the surface strata in parts of the Plateau. On Mt. Carmel and in the foothills of the Plateau and parts of the southern and eastern slopes the Senonian limestone is general on the surface. Galilee shows the same general features, but here patches of Eocene limestone and outcrops of basalt occur at several points. The floor of the Jordan Rift is lacustrine.

Of Transjordania it is impossible to say much till a more complete botanical, geological and meteorological survey

of the country has been made. Its main features may be summed up as follows. Roughly, as far as the Hejaz Railway it is a Plateau broken by deep river valleys issuing into the Jordan Rift, higher on an average than the Plateaux of Palestine, with several mountain ranges arising from it which reach 4,000 ft. near Salt and over 5,500 ft. near Petra. The climate is more extreme in winter and summer than that of Palestine; the rainfall somewhat less but not inconsiderable in the higher portions of the country. There is a fair amount of scrub forest in certain areas in spite of the depredations of the inhabitants, *e.g.* about Ajlun, where some fairly high oak forest is also said to survive; in the Hishe District near Maan, where there is Juniper forest, and north of Salt, where there are thin pine-woods on some of the mountains. The Plateau falls to the east and eventually dies down in a belt of steppe beginning more or less at the Hejaz Railway, which gives place to a gravel and rock desert some 50 miles further east. At Azraq, 70 miles east of Amman, there is a marshy area of inland drainage forming an oasis in the desert. The flora on the whole resembles that of Palestine.

The geological formation is Senonian limestone underlaid in the south by Nubian sandstone in two strata, the lower of which appears to be definitely of the Carboniferous period, while the higher may be Cretaceous, but so far has not been found to contain any fossils. This Nubian sandstone appears at the south end of the Dead Sea, and reaches Plateau level in part of the Petra area. There are several volcanic (basalt) outcrops in Moab and further north.

Of two Transjordanian localities Mr. Philby writes as follows :—

" Jebel Suwada is the general name of the range (containing Jebel Osha) overlooking the Jordan Valley near Salt. I have an aneroid reading of 26·00 for it on April 19, 1923, the reading at Salt an hour later being 26·81, while I have a reading of 27·34 at Amman at 7 a.m. on March 31. Taking Amman to be 2,700 ft. above the sea-level, Salt would be about 3,000 ft. and Jebel Suwada about 4,000 ft. The latter is rocky limestone hill country richly cultivated with vines. . . . Where not cultivated it has a good deal of oak and other scrub, but no forest trees.

" For Petra (Qasr el Bint, which is the lowest part of the Petra area) my readings make it about 3,000 or 3,100 ft., the sandstone hills rising above this point another 800 or

1,000 ft. To the east the sandstone disappears under the great limestone range, which rises to 5,500 ft. above sea-level. . . . I am afraid I cannot give you exact temperature figures, as the only record I have is a reading of 79° Fahr. about noon on March 31, at Qasr el Bint. Generally the area is very hot and dry through the summer, but with cooler nights and mild in the winter, though it can be quite cold and is very cold at night. Probably no frost in the valleys, though it doubtless freezes on the hilltops at night, and heavy snows fall and lie on the limestone range above 4,500 ft. in December, January and February. I have never seen snow on the sandstone area even on its higher points. Generally speaking I should say that the Petra area, excluding exposed hilltops, is immune from frost, though it probably experiences temperatures as low as, say, 38° to 40° in the depth of winter, with maximum day temperatures of from about 80° to 85° in the winter months. In the summer the maximum would reach 100° to 110° from June to September, with minimum night temperatures of 55° to 60° or higher during that season. . . . Geologically the whole of the Petra area proper is Nubian sandstone . . . and the overlying limestone to the east is Upper Cretaceous."

As regards the effect of the climate on the bionomics of the Rhopalocera of Palestine, the "summer pause" in the emergence of the majority of the Rhopalocera and Grypocera, which is well marked at low and moderate altitudes in the Mediterranean sub-region, especially in dry localities, is certainly long in Palestine, but here and in Syria more data are required before any assertion can be made as to its duration at different levels. My own impressions may be set down as follows. At Beirut, which I visited three times in July and August, and which is a distinctly damp locality, Lepidoptera were generally rare, with the exception of certain heat-loving species of non-Palaearctic affinities, e.g. *T. fausta*, *A. acamas*, from July 10–15 to late August, after which they grew quite common. In the wet valley of the Dog River little was moving in August before the 25th of the month. Butterflies had been common in the first ten days of July. At moderate altitudes, 1,500 ft. to 3,000 ft., little was visible after July 20, but butterflies were frequent and second broods fresh at Ain Zahalta in all but the driest places at from 3,500 to 4,000 ft. At still higher altitudes I have remarked no sign of a summer

pause. In the southern steppe *P. cardui*, *B. mesentina*, and in damp places a few *Z. karsandra*, were the only butterflies seen more than singly from the middle of July till the end of August. In September-October fresh broods of *T. balcanica* and *E. alceae* emerged and a few *P. icarus* occurred. In November were taken a few *P. cardui* and one or two *C. crocea*. This, however, was a very dusty sandy area which had been overrun by a very large army and its transport for months and had been eaten bare by animals.

In the Palestine Hill country and even at lower levels spring emergences depend largely on weather conditions. My personal impression is that emergence is delayed by a dry winter in the case of species which oviposit in the early winter or late autumn and reappear in the imaginal stage in the spring. Thus *E. charlonia*, which appears after the early rains at Jericho in November, produced a numerous and fresh vernal brood in mid-March 1921, a wet year. In the following year, which was marked by a drier winter, this brood was well out in February and nearly over by March 18. But the correspondence of emergence from the pupa with atmospheric pressure is a subject which requires much more study in the Mediterranean countries, especially in those where "steppe" conditions prevail, than has hitherto been given to it, and it is to be hoped that entomologists resident in Palestine will be able to collect the data which are indispensable before it is possible to come to any definite conclusions.

2. *The Faunas of Palestine.*

Before analysing the faunistic constituents of the Rhopalocera and Grypocera of Palestine and Transjordania, it is necessary to examine the character of the Vertebrate fauna of these countries. Here one is struck by the combination of Tropical, generally Ethiopian, and Palaearctic forms, Mediterranean species and genera being in the ascendant among the latter. Here, however, it is necessary to draw a distinction between the species which are characteristic of the more barren parts of the Mediterranean zone of the Palaearctic Region and those which are generally speaking confined to its better-watered and more fertile districts. The latter will hereinafter be described as Mediterranean, the former as Steppe species, but the line between the two is not very clearly defined

in many instances. The Palaearctic species, which are not Mediterranean, *sensu lato*, are "Siberian," by which phrase the zoogeographer describes a fauna characteristic of a well-watered area, with generally hard winters, abundantly wooded and only exceptionally subjected to long spells of dry heat, which extends from the Atlantic to the Upper Amur.

Taking first the Mammalia, it is a little difficult to place some of the existing or recently extinct species in their zoogeographical context. The Felidae are a case in point. Is the Lion, which appears to have been finally killed out in Palestine in the eleventh or twelfth century A.D., to be regarded as a tropical invader of the Palaearctic region in the form of *Felis spelaeus* or a Palaearctic like *Felis tigris*, which has successfully established itself in the tropics? On the other hand, the Desert Cat, *F. chaus*, which occurs in many parts of Palestine, the Leopard and the Cheetah, which occur in the Southern Jordan Valley and in Transjordania respectively, seem rather to be of non-Palaearctic origin, as are *Genetta vulgaris* and *Herpestes ichneumon*, which, if they reach Southern Europe as do species of the Lycaenid genus *Tarucus*, are none the less obviously non-Palaearctic in their immediate kinships. There is a markedly large proportion of "Mediterranean" or more properly "steppe" species among the Palestine rodents, the genera *Dipus*, *Spermophilus* and *Spalax* being represented. The Bear (*Ursus arctos syriacus*) and the now extinct Roebuck are obvious Siberian invaders, but nothing could be more Ethiopian than the Palestinian Hyrax (*H. syriacus*), a species of the Rift; while the bats with *Rousettus aegyptiacus*, the cosmopolitan tropical *Miniopterus schreibersii*, the Indian *Rhinopoma microphyllum* and the African *Taphozous nudiventris*, not to mention other species, contain a strong invading element.

The Avifauna of Palestine is still more remarkable. Of the 348 species recorded by Tristram, 40 are Ethiopian, 7 Indo-Malayan and 30 peculiar either to Palestine proper or to that country and the neighbouring regions of Syria and Arabia. Of these endemic species some are apparently local modifications of Palaearctic species, others, such as the Sunbird *Cinnyris oseae* and Tristram's Grackle (*Amydrus tristramii*), most certainly Ethiopians. The Darter, which occurs on the Huleh marshes as a migrant and nests on the Lake of Homs, is an interesting example of an Ethiopian

member of a species which may have acquired the habit of migrating from the Lake region to Palestine when the Red Sea was still a lake communicating with Nile and Jordan by long-vanished waterways. *Ceryle rudis* is Ethiopian and Indian, *Cotyle obsoleta* and the little Raven, *Corvus affinis*, Ethiopian, the latter with Abyssinia as its nearest habitat to the cliffs and gorges of the Jordan Rift. The Jordan Valley is the most westerly breeding place of *Halcyon smyrnensis*, an occasional straggler in Asia Minor, and another remarkable case of discontinuous distribution is furnished by the Ceylon Fish-owl, *Ketupa ceylanensis*, which occurs near Haifa and in the Jordan Rift. Of the endemic species the majority appear to have their principal habitat in the Jordan Valley, to which some, e.g. *Passer moabiticus*, which has an extraordinarily restricted distribution, seem to be confined.

The proportion of Mediterranean and Steppe species among both residents and migrants is large. The genera *Saxicola*, *Pterocles* and *Lanius* are well represented, and the Desert Trumpeter Bullfinch (*Erythrospiza githaginea*) and the very local *Carpodacus sinaiticus* of the southern steppes are interesting examples of Desert species with a very restricted habitat. The Reptiles and Amphibia show the same varied geographical origin. It is doubtful whether the Crocodile, which may yet survive near Athlit, was introduced, as local legends aver, from Egypt. Palestine appears to be the southern limit of the Palaearctic *Tropidonotus natrix*; *Daboia xanthina* is near the terrible Indian *Daboia russelli*, and is a Western species of an Indo-Malayan genus, and the Jordan Valley Oligodont, *Rhyncocalamus melanocephalus*, appears to be of Indo-Malayan origin. According to Tristram, 42 out of 91 species of reptiles and amphibians are non-Palaearctic.

The freshwater fish of the country are of extraordinary interest. While the species occurring in the streams which flow into the Mediterranean generally resemble those of Syria, one Mediterranean species alone occurs in the Jordan system with 2 species which occur in the Nile, 17 identical with or very close to species occurring in the Tigris, the Euphrates and the lakes and streams of the inland drainage system of the Damascus oasis, and 16 are quite peculiar but are unquestionably of tropical (Ethiopian) origin. *Clarias macracanthus*, one of the 2 Nile species, is not found in the Lower Nile. The peculiar species belong

to the genera *Chromis* and *Hemichromis*, which are characteristically Sudanese (Ethiopian). Their presence appears to prove a former connection between the Jordan Valley system and the Nile, at a period when the latter river flowed into a Red Sea Lake connected temporarily with the Jordan system.

On the other hand, the aquatic Invertebrata of the Sea of Galilee, which have been the subject of research by the late Dr. Annandale (Journ. & Proc. Royal As. Soc. Bengal, 1916), are for the most part Palaearctic, a majority of the species occurring in non-Palaearctic waters being cosmopolitans. Dr. Annandale (*loc. cit.*) suggested that the changes in temperature, levels, etc., which have taken place in the Rift Valley since the Pliocene period, have been so considerable as to destroy the greater part of this fauna, a few particularly hardy and therefore cosmopolitan forms, and those fish of the Ethiopian genera, which he considered to be particularly adaptable species, alone surviving as a vestige of the pre-glacial fauna of these waters.

In contrast, the Palestinian Odonata, water-insects in their larval stages, include several non-Palaearctic species. Of 10 such recorded out of a total of 39 by Dr. K. J. Morton in his paper on the Dragon-flies (Odonata) of Palestine, Trans. Ent. Soc. 1924, pp. 25–44, 5 have so far only been recorded from the streams of the Jordan basin. The well-known Indian *Agriocnemis pygmaea* is among these, and it may be noted that the Indian *Anax immaculifrons* has been taken in Syria. The other 9 non-Palaearctic species are certainly Ethiopian.

To turn to the Rhopalocera and Grypocera of Palestine there can be no question that the following species are either non-Palaearctic or are recent Palaearctic modifications of invaders from non-Palaearctic habitats. These are *Chapra mathias*, *Gegenes nostrodamus* and *G. lefebvrii*, *Apharitis acamas*, *Virachola livia*, *Epamera* (*Iolaus*) *jordanus*, *Lampides boeticus*, *Syntarucus telicanus*, *Azanus jesous gamra*, *Tarucus balcanica* and *T. mediterraneae*, *Chilades trochilus*, *Zizeeria karsandra*, *Belenois mesentina*, *Teracolus fausta*, *T. phisadia palaestinensis* and *T. chrysonome*, *Danaida chrysippus*, *Yphthima asterope*. To these in my opinion should be added, in spite of its world-wide distribution, *Pyrameis cardui*, which only seems able to establish itself as a permanent resident in the warmer

parts of S. Europe, *Charaxes jasius*, which is very close to *C. epijasius* of the Sudan and is believed by Seitz to be merely a geographical race thereof, and possibly *Chilades galba*—22 species altogether out of 79.

The separation of Steppe and Mediterranean from Siberian Palaearctic species is not an easy task. We can be sure where some species originated, but others, *e.g.* the Epinepheles, may equally well be Southerners which have in certain cases adapted themselves to Siberian conditions, or Siberians which have evolved a great number of new forms under climatic stimuli in the Mediterranean and Steppe areas. But certain species of the Palestine list seem indubitably of Mediterranean and Steppe origin. Such are unquestionably *Papilio alexanor*, *Zerynthia cerisyi*, *Pontia daplidice*, *Zegris eupheme*, *Euchloe belemia*, probably *E. ausonia*, and certainly *E. charlonia*, *Anthocharis gruneri*, *Scolitantides bavius*, *Tomares nogelli nesimachus*, the four Palestinian species of the genera *Satyrus* and *Hipparchia*, *Agapetes* (*Melanargia*) *titea*, *Hesperia proto*, *H. nomas*, *H. melotis*, *H. phlomidis*, and *H. orbifer*. In other cases, e.g. *Polygonia egea* and *Limenitis rivularis*, with *Thymelicus hyrax*, perhaps *T. acteon*, *Melitaea arduinna*, *Plebeius loewii*, we have characteristically Southern or Steppe representatives of what seem to have originally been Siberian genera.

The absentees from the Palestinian fauna also deserve attention. A number of species, some Siberians and even Alpine species, e.g. *P. mnemosyne*, *M. cinxia*, *Argynnis niobe*, *C. pamphilus*, and a number, too, of Mediterranean and especially Mediterranean mountain species, such as *P. roxelana*, *D. pandora*, *Heodes thetis*, *H. ochimus*, *Turania panagaea* and many more, do not extend further south to all appearance than the middle heights of S. Lebanon and Mt. Hermon. Some of these may be eventually discovered in Transjordania. Surprising absentees are *I. podalirius*, *I. latonia*, and *P. egeria*. There are also certain curious anomalies of distribution in the records so far obtained, *e.g.* the apparent absence of *A. apollinus*, *A. cardamines* and *E. telmessia* from Transjordania, all three widely distributed in Palestine, but not discovered in the districts wherein Mr. Philby collected.

It remains to inquire how this tropical and mainly Ethiopian element in the country's fauna entered Palestine. The theory has been advanced that this is a relic of the Miocene or early Pliocene fauna, which survived the glacial

period in the comparatively warm Rift, possibly at a point further south than the Dead Sea. This view appears to have been held by Canon Tristram, to judge from the Introduction of his "Fauna and Flora of Palestine." There is a belief among many zoogeographers that the Jordan system before the salinisation of the Dead Sea was not a land-locked basin but was connected in some way, possibly through the Wadi Araba, with the basin of the Nile, which is believed by some geologists to have at one time entered the Red Sea Lake somewhere near Kosseir. There is evidence of fairly recent volcanic activity in Transjordania and the Hauran, and it is possible that the changes in the levels of the Wadi Araba which would seem to prohibit such a fluvial connection are of geologically recent date.

Against the view that the Jordan Valley fauna is a Miocene survival one must set certain palaeontological and geological facts. During the later stages of the pluvial (glacial) period the whole of the Jordan Rift was filled by a freshwater lake, which, to judge from the terraced deposits on the slopes of the Valley, must have attained a surface level some 200 ft. higher than the present sea-level. This lake was fed from the extensive glaciers of the S. Lebanon and of Mt. Hermon. The fauna of the latter mountain in late Pleistocene times included such boreal forms as the elk and reindeer, and the Alpine vole, *Arvicola nivalis*, survives on the summit of Mt. Hermon to this day.

It seems most improbable that the mainly Ethiopian fish-fauna and the tropical dragonflies of the Rift could have existed in any part of the late Pleistocene Jordan Valley, which *ex hypothesi* was filled in many places literally to the brim by glacier water and exposed to icy gales from snowy summits. It is equally unlikely that the tropical Rhopalocera and Grypocera of present-day Palestine could have haunted the banks of this chilly lake. On the other hand, it seems possible that the existence of certain Palaearctic butterflies far within the Ethiopian region, *e.g.* forms of *P. brassicae*, *C. hyale* and *H. phlaeas*, and *Pararge maderakal*, a close ally of *P. maera*, may date from the later stages of the glacial period, when the ice had retreated sufficiently from Asia Minor and the Syrian mountains to enable a "Siberian" fauna, which had developed in the less glacial areas of Eurasia, to make its way southwards aided by the continuance of Palaearctic conditions at the higher

levels along the mountain ranges of W. Arabia and finally to reach the Ethiopian region.

Another question which has some bearing on the origin of the non-Palaearctic element in the Palestinian fauna is that of the level of the Eastern Mediterranean Lake. It is certainly conceivable that prior to the breaking of the African land-connection with Sicily of which Malta is a vestige, this was much lower than that of the present Mediterranean Sea. The former connection of Cyprus with the present W. Asiatic continent must have endured long enough after the end of the glacial period for various Rhopalocera of tropical origin to establish themselves there after colonising parts of Syria and Palestine. It is conceivable too that the E. Mediterranean Lake depression bore the same relation to the present Coastal Plain of Palestine that the Jordan Rift Valley now bears to the Plateau, and that it was connected by waterways with the Jordan Lake (by what is now the Plain of Esdraelon), which drained into it and with the Nile–Red Sea Lake. This may explain the Ethiopian fish-fauna of the Jordan.

In any case, it appears quite certain that the Ethiopian (and Indian) elements in the fauna and flora of Palestine could not have established themselves in the Jordan Valley till the cessation of the glacial period and the partial desiccation of the Jordan Lake. They may have entered Palestine from the south-west along the coast of the E. Mediterranean Lake from the Red Sea. They may have made their way from the south up the Wadi Araba even more recently, during a period when (pluvial) glacial conditions were rapidly giving way or had yielded to Steppe conditions, but desiccation had not made the progress that it appears to have made in recent and indeed historic times in N. Africa and W. Asia. Some of these species, e.g. *C. trochilus*, the *Teracolus* spp., *A. acamas*, *B. mesentina* and the Grypocera of tropical origin or affinities—*Baoris zelleri*, a Syrian species, occurs not only in Nilotic Egypt but in the Bahrieh oasis — occur in favourable areas in the deserts of Arabia and N.E. Africa. *Y. asterope* and *C. galba*, which occur in Cyprus, and are not butterflies of strong flight like the species of *Parnara* (*sensu lato*), may represent an earlier movement along the coast of the Mediterranean Lake before the inroad of the sea through the breached Malta barrier.

My personal impression is that the Ethiopian element

among the Rhopalocera and Grypocera of Palestine is of comparatively recent origin, dating from a period posterior to the existence of extensive glaciers in the Lebanon; that the present concentration of so many of the species of this fauna in the Jordan Valley must date from a period subsequent to the complete or almost complete disappearance of these glaciers; that the colonisation of Palestine by some of these species may be connected with human agricultural activities, e.g. *Virachola livia*, which must have originally had one of the African species of *Acacia* for its food-plant, feeds in Egypt and Palestine on the pods of the imported *Acacia farnesiana*, which is extensively grown as an ornamental and hedgerow plant, and on the pomegranate. *Z. karsandra*, which feeds on the widely cultivated "bersim" clover (*Trifolium alexandrinum*), and perhaps *Chapra mathias*, which has sorghum and rice among its graminaceous food-plants; that the Siberian element in the fauna of Palestine may date from the later stages of the glacial periods, and that the Mediterranean element represents in part an adaptation of Siberian species to Steppe and semi-Steppe conditions, in part a fauna evolved in the Mediterranean Lake region and the adjacent countries south of the glacial areas, more especially during that late geological period in which such Steppe species as *Zegris eupheme* made their way as far west as Spain. This fauna may possibly contain a primitive (Miocene) element in *Archon apollinus*.

PART II.

Systematic.

The Butterflies of Palestine.

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Abbreviations. See also under Bibliography, Appendix B.

sp. = Species (singular).
spp. = „ (plural).
Gen. = generation.
Gens. = generations.
B.M. = British Museum.
Coll. = Collection.
ab. abs. = aberration, aberrations.
f. = form.
locs. = localities.
subsp. = subspecies.
descr. = description, described.
nr. = near.
Dist. = district.
approx. = approximately.
Mus. = Museum.
Jord. Vall. = Jordan Valley.
Sin. Pen. = Sinai Peninsula.
Wa. = Wadi, *i.e.*, Valley, watercourse.
B. = Bir, *i.e.*, Well.
A. = Ain, spring.
Jeb. = Jebel, *i.e.*, Mountain.
} In geographical names.

The points of the compass are represented by capital letters. Dates and months in Roman numerals. b. = 1st–10th inclusive of a month, m. = 11th–20th inclusive, e. = 21st–end inclusive. Thus m.VII. = middle of July, *i.e.*, between the 11th and 20th July inclusive.

GRYPOCERA.

1. **Carcharodus alceae** Esp. subsp. **australis** Zell.

Zeller, Isis, 1847, p. 285. "Sicily."

Distribution. Never common, but found in small numbers in many locs., *e.g.* Haifa (v. Kalchbg.), Gaza (Mus. Min. Agr.), Jerusalem Dist. (Buxton), Jericho (P.P.G.), Beisan Dist. (Hemming Coll.), Umm el Kilab in sandy steppe nr. Egyptian border (P.P.G.), Ain Sara on E. shore of Dead Sea (Philby).

Dates. At Jericho in m.III. Gaza, IV. The 2nd Gen. appears in Syria and Palestine from e.V. to VII. according to altitude, *e.g.* Haifa 22.VI. Jerusalem 8.VII. (P.A.B.). 3rd Gen. examples from Umm el Kilab in IX. Ain Sara 26.XI.1923.

Variation. My Jericho example is *alceae*. I cannot say whether the race described by Verity as *praeaustralis* (Ent. Rec. xxxvi, p. 106, "Monreale, nr. Palermo") occurs in the 1st Gen. in Palestine. The 2nd Gen. examples and those of the 3rd are *australis*, and some of the latter from Umm el Kilab are very pale indeed, though they are not nearly so sand-coloured on the upper-side as are summer specimens from Iraq (form *isolatrix* Le Cerf, cf. Journ. Bomb. N.H. Soc., vol. xxviii, No. 2, p. 266). I took these last flying about a Composite plant which looked very like an example of *Phlomis*. I saw no *Malva* in the steppe.

2. **Carcharodus boeticus** Rbr. subsp. ?

Rambur, Ent. And., Pl. XII, figs. 3, 4. (1839), "Andalusia."

Distribution and Dates. I have only seen a few specimens from Palestine, viz. those taken by Dr. Buxton 10 m. E. of Jerusalem 17.IV.1922 and (1 only) at Tel el Milh nr. Bir Saba (Beersheba) 12.V. All are males. Capt. Hemming has received some very interesting specimens from the Beisan District taken at from 300 to 400 ft. below sea-level from 16.V. to 20.V. I have also seen a specimen taken at Ain Karim in May in Consul Petroff's collection. Herzog reports the capture of three specimens near Haifa on 4.V., described as *altheae* but probably *boeticus*. Among Mr. Philby's Transjordanian captures is a ♂ from Jerash taken 19.V. I have examples from Beirut taken in V. and VII. and from the Cilician Taurus in my collection. Occurs in Asia Minor and parts of Greece.

Variation. The specimens from Beirut, Transjordania and Palestine appear to me to differ from the nymotypical race from Andalusia, but as the material before me is scanty, comprising only one worn ♀ from Beirut, I abstain from naming it, the more readily as I have seen no specimens of the Sicilian and Greek races. The examples in the Hemming Coll. are not yet set. Their undersides are very pale with rather rufous chequered marking, reminding one

of very pale *stauderi* Rev. The race from Asia Minor, to judge from my Cilician specimen, differs from that of Palestine. Certain "Syrian" specimens from the Mutzell Coll. in the B.M. resemble the Cilician specimen in having very light (yellowish) fore-wings and dark hind-wings less marked with pale bands and spots than is the case in the Beirut race. These perhaps come from N. Syria.

3. **Carcharodus orientalis** Rev. subsp. ?

Reverdin, Bull. Lep. Soc. Gen., vol. ii, pp. 230—232, Pl. XXI, fig. 14, and p. 233, fig. 4 (genitalia). "Peloponnese."

Among Mr. Philby's captures are a ♂ and a ♀ taken, the ♂ at Wadi Sir, Transjordania, 14.VIII. and the ♀ at Zarqa 26.VII., also in Transjordania. The ♀ is in bad order. The genitalia of the ♂ are nearest to those of *C. orientalis*, of which I have many specimens before me taken in the Constantinople District, Macedonia, Smyrna and Greece and the higher levels in Mt. Lebanon. The extremity of the clasps is, however, rather narrower and terminally more rounded than in *orientalis* of the 2nd Gen. from Constantinople. On the other hand, the general shape of these appendages is that of *orientalis*, their ventral face being only slightly convex, while in *boeticus* it is distinctly angulate (cf. outlines given on p. 233 of Bull. Soc. Lep. Gen., vol. ii). The 2nd Gen. of *C. orientalis*, to which these specimens belong, is smaller than the 1st Gen., and to judge from my material shows a certain approach to *boeticus* in the design of the under surface of the hind-wings. My single specimen of *C. orientalis* from the Anti-Lebanon (taken at Baalbek e.V.1906) appears to belong to a distinct pale race, with very light underside and large pale spots and bands on the upperside of the hind-wings. In the Hemming Coll. are a few still unset specimens from Nablus with undersides resembling my Baalbek specimen, taken 7–18.IV. I expect this race, when more material is forthcoming, will prove to deserve a name. Mr. Philby's Transjordanian specimens may represent the second brood of this race, since they bear the same relation to it that the 2nd Gen. of Constantinople *orientalis* bear to the 1st Gen.

(In Consul Petroff's Coll., which I saw at Alexandria early in 1916, was a curious example of *Carcharodus* taken in May at Ain Karim, which, if my memory is not inaccurate,

bore a considerable resemblance to *C. taurica* Rev. from Cilicia. This species may occur in Syria, Palestine and Transjordania, and should be looked for in those countries.)

4. **Hesperia (Muschampia) proto** Esp. subsp. ?

Esp., Pl. CXXIII. figs. 5, 6. Deser. by Ochsenheimer. i. 2,210. "Portugal."

I have only one example, a rather worn ♂ of this species from Palestine, taken at Wa. Biar nr. Jerusalem (P.A.B. 16.X.1921). The species occurs locally in Syria, Beirut, Aleih, Cedars of Lebanon, etc., from sea-level to 6,600 ft. at the last-mentioned locality. The colour of the underside of the hind-wings is very variable, and the Syrian race, given more material, may prove to differ considerably from the nymotypical (Iberian) race of *proto*.

5. **Hesperia (Muschampia) nomas** Led. subsp. **nomas.**

Lederer, Zool-Bot. Ges. Wien, 1855, p. 193, Pl. I. fig. 7. "Beirut."

Distribution and Dates. Occurs on the Plateau, apparently in small numbers, *e.g.* Kolonia, 22.IV.1922 two fine ♀♀, Ain Karim 23.IV.1922 ♀ somewhat worn. The B.M. contains two fine ♂ examples from "Palestine," locality not given. *H. nomas* occurs all over the Lebanon and Anti-Lebanon in small numbers and also on the coast near Beirut, its flight beginning in IV. at low or moderate elevations and continuing into early VI. at higher altitudes. I have no evidence of a 2nd Gen.

Variation. Palestine specimens resemble the Syrian *nomas*. This species was first described as a race of *H.* (*M.*) *tessellum*, but has been separated by Reverdin on the evidence of the ♂ genitalia. Its most obvious character differentiating it from *tessellum* is the white unmarked uniformity of the underside hind-wings.

6. **Hesperia melotis** Dup. subsp. **melotis** (**hypoleucos** Led.).

Duponchel, i, p. 257, Pl. XLII, figs. 1, 2. "Greek Islands."

Distribution and Dates. This species occurs in a good many localities in Palestine both on low and high ground, though it does not seem common anywhere. In Syria there are two generations, possibly three at low or moderate elevations. I have taken it there at Beirut in early May and early

July (very fresh), and at Damascus in September, while in the Lebanon it is well out by mid-May. Palestine records are : Akka 9.VI.1921, Bittir, Judaea ♂ 23.V.1922, Nazareth ♂ worn 30.VI.1921, Beisan in Jord. Valley ♂♂ 23-28.VII.1922, ♀♀ 23.V.1922 (Buxton Coll.), 19.VI. (Hemming Coll.).

Variation. Specimens in which the Hesperiid pattern on the underside of the hind-wings is perfectly visible and sometimes even well marked, and others in which it is extremely indistinct and the whole surface of the wing is clouded with whitish scales, so that even the bold white dash from margin to base in interspace 5 is not noticeable, occur in both generations and both sexes. The size of the white spots on the upperside is also variable, independently, as far as I can judge, of the sex.

7. **Hesperia (Powellia) orbifer** Hb. subsp. **hilaris** Stgr.

Stgr., Reb. Cat. 1902, p. 96. "Mardin, Syria."

Seasonal Form (Gen. 2, *hilaris* f. *secunda*, mihi).

Distribution and Dates. Widely distributed on the Plateaux of Palestine, also occurring in the foothills and at Haifa (Mt. Carmel), and the most frequent of the "black and white skippers," as it is in many other parts of the Near East. There are certainly two broods in Palestine and in Syria (Beirut, Leb., Anti-Leb.), where it is frequent, possibly three, for I have taken very fresh examples of the small summer form at Beirut in early September. These may, however, have been of the 2nd Gen., the emergence of which had been delayed by the summer pause, which in Beirut, in the case of some species, appears to cover the period from mid-July to mid-August. I have a fair number of Syrian and Palestinian examples of the 1st Gen. (*hilaris*) taken at various times between mid-April and early June, according to altitude. In Palestine I should say that m.IV. to e.V. and e.VI. to VIII. are the periods during which the 1st and 2nd Gen. respectively fly. So far I have seen no specimens from the Jordan Valley, Transjordania or the southern part of the Coastal Plain. Haifa and Mt. Carmel, Nazareth, Tulkeram, IV., Wadi Kabala to the W. of Jerusalem, A. Sinia, the Wilderness of Judaea 10 m. E. of Jerusalem (17.IV. P.A.B.), Jerusalem (20.IV.1918, Mus. Min. Agr. Cairo, and in the 2nd Gen. 16.VI.–29.VII. Swinton), Imam Ali, 1,700 ft. VII. are among its localities.

Variation. Staudinger's description of subsp. *hilaris* is "alis maculis albis majoribus pluribusque." He gives Mardin and Syria (ab.) as localities, but in my experience the Syrian *orbifer*, if they do not usually show so much and so large white spotting on all wings as those from Mardin, are more heavily marked with white than long series in my collection from E. Thrace, Bithynia, etc., and than Macedonian specimens. The hind-wings of Syrian specimens usually have a well-marked central band of spots on the upperside. In those from north Asia Minor and Thrace this band is often rudimentary, sometimes absent. The submarginal spots, too, on the hind-wings are better developed as a rule among the Syrian specimens than in those from north Asia Minor. A few Smyrna specimens do not differ very markedly from those from Constantinople. The Greek race, of which I unfortunately have little material, seems to differ from the Turkish, which I take to be *orbifer orbifer*. The nymotypical *orbifer* figured by Hübner looks like a Turkish or Hungarian example. The 2nd Gen. of *hilaris* from Syria is more heavily marked with white than the 2nd Gen. of the nymotypical race, and should therefore I think be called *hilaris* f. *secunda* instead of *minor* Rbl., which should be confined to Gen. 2 of *orbifer orbifer*. It is much smaller than *hilaris*, to which it bears the same relation as Gen. 2 *gracilis* of *H. sao* bears to the nymotypical Gen. 1.

8. **Hesperia (Powellia) phlomidis** H.S. subsp. ?

Herrich-Schaefer, p. 153, Pl. II (Hesp.), figs. 8, 9. "Turkey on Sea of Marmora."

Distribution and Dates. The only record of this Near Eastern "skipper" from Palestine occurs in Kneucker's paper (Verh. Naturw. Ver. Karlsruhe, xxi, p. 145). He took *phlomidis* at Bittir (1,800–2,000 ft.) some miles W. of Jerusalem near the Jaffa-Jerusalem Railway on June 4, 1904. It occurs in several localities in Asia Minor and on the bare summit of the mountain above the Salahia quarter of Damascus in early May. It also occurs in Greece (mountains) and W. Macedonia (N. of Monastir). Should be looked for in Palestine and Transjordania.

Variation. The Syrian *phlomidis* which I have seen appear to me to be more heavily marked with white

spotting than those from Greece and Asia Minor, but I have not seen enough specimens to feel justified in erecting a subspecies of *phlomidis* on the strength of a short series.

(Note.—The allied *P. amenophis* Reverdin, described from the desert E. of Cairo, and taken by me both there and near Qassassin, on desert where *Convolvulus lanatus*, its food-plant, grows, has been taken (Mus. Min. Agr., Cairo) at or near Mehemdia, a station on the railway between Kantara and Katia in Northern Sinai. It may very possibly occur in the desert south of Beersheba in the extreme south of Palestine and in parts of the Ghor south of the Dead Sea. It should be looked for by future collectors in desert where its food-plant grows. This Convolvulus is very conspicuous in April and May, when it flowers, the extremely white petals being visible at an appreciable distance. But after midday they fold up as do the flowers of other species of Convolvulus.)

9. **Thymelicus flava** Brunn. subsp. **syriaca** Tutt.
(Pl. V, fig. 4.)

Tutt, Brit. Lep., vol. viii, p. 107. "Syria."

Distribution and Dates. 10 miles E. of Jerusalem 17.IV.1922 (P.A.B.), nr. Ain Sinia, 2500 ft., not recorded from Haifa by v. Kalchberg. ♀♀s nr. Beisan, very worn, V. (but possibly *T. lineola*) in Hemming Coll. Occurs at heights of from 2,500–4,500 ft. in Lebanon and also on Mt. Hermon. Found in Cilicia (Shar Deresy), and generally distributed in Asia Minor and the Balkans. It will probably be found to occur fairly generally on the higher Palestinian Plateaux.

Variation. Tutt *fide* Oberthür described the Syrian race as being of a clear light ground-colour, lighter evidently than his subsp. *iberica* from S. France, the Iberian Pen. and Italy (Verity). Subsp. *syriaca* has other characters which differentiate it from both *iberica* and the race to which I temporarily only give the name of *major*, applied by Tutt to examples from Fusio and other localities in the Southern Alps, a race which occurs in Macedonia, E. Thrace and part of Asia Minor, though this name must eventually fall as a subspecific name, since Tutt had already given it to the *lineola* race or form of Wolfsberg, Villach, etc. ? *major* is characterised by its large size, a more important criterion in a single-brooded species than in one with more than one

generation, bright ground-colour and strongly marked blackish margin.

Syriaca as compared with *iberica* and this N. Levant race has the following characteristics :—

1. Slightly smaller size, compared with ? *major*, larger than *iberica*.
2. More acuminate wings in the male than in either.
3. Paler golden-brown upperside, the colour in the ♀ being very light.
4. Less suffusion of black scales on the base and anal margin of the hind-wings than in ? *major* and some *iberica*.
5. Thinner and far more clearly defined dark margin and lighter fringes than in either subspecies, especially ? *major*.
6. Underside hind-wings much lighter owing to the relative infrequency of black scaling, which mixed with the yellowish-orange scaling produces a greenish effect in the more northern subspecies. In *syriaca* ♀♀ from near Jerusalem and Lebanon the effect is whitish-ochreous over the greater part of the hind-wing, owing presumably to an admixture of very pale ochreous or cream-coloured scales.
7. No trace of a spot closing the discoidal cell in the ♀. This is also a character of *iberica*. In ? *major* a larger number, perhaps a majority, of ♀♀ have such a spot, usually faintly marked.
8. Much pale scaling on the sides of the abdomen in some ♀♀.

The race from Shar Deresy in S. Cilicia and specimens from Yozgad (Central Asia Minor) in the B.M. appear to be transitional in some respects, while the race from Amasia seems identical with *syriaca*. Examples from Greece (Parnassus, ex Merlin Coll. in B.M.) are *syriaca*.

10. **Thymelicus lineola** O. subsp. **major-clara** Tutt. (Pl. V, fig. 3.)

Tutt, Brit. Butt., viii, p. 96. "Tragacete" (E. Spain).

Tutt's type cannot be found. A series of 5 ♂♂ and 5 ♀♀ taken in Sicily by Zeller and now in the B.M., and

2 ♂♂ and 2 ♀♀ taken 10 m. E. of Jerusalem, 17.IV.1922, of which a ♂ and a ♀ are in the B.M., agree, by reason of their large size, sharp proximal outline of the dark margins, clear bright ground-colour and pale undersides, with Tutt's brief description of the Tragacete form. The subsp. *major-clara* doubtless occurs in other Mediterranean countries.

Distribution and Dates. Swinton records *lineola*, probably of this form, from the Mt. of Olives near Jerusalem, from 2.VI. to 16.VI. and near Beisan, Jordan Valley at —100 ft. 11.V., both sexes worn: rather late dates, as it is out at Baalbek, a much colder Syrian locality, nearly 4,000 ft. above sea-level, at the end of May. Transjordania (Philby). Occurs in the Anti-Lebanon and locally on Mt. Lebanon, *e.g.* Cedars of Lebanon, very small worn specimens at 6,600 ft. e.VIII.1910.

Variation. The race from Shar Deresy appears transitional from *lineola* to *major-clara*. The specimens from the Cedars are not *major-clara*. I have not enough material before me from the Anti-Lebanon to determine the form. In the B.M. is a very pale example labelled "*diluta* Syria" in Zeller's handwriting. Unfortunately this name does not seem to have been published. The example would seem to be an extreme form of *major-clara*. I suggest that *diluta* should be employed, if at all, to describe such examples, while the name *pallida* Tutt, Brit. Butt., viii, p. 97, should be reserved for pale aberrations of the typical form from Central Europe.

11. **Thymelicus hyrax** Led. subsp. **hyrax.**

Lederer, Wien. Monatschr. 1861, p. 149, Pl. I, fig. 6. "Antioch."

Distribution and Dates. First recorded from Palestine by von Kalchberg, who received it from Haifa. Apparently local, but may have escaped detection owing to its resemblance to *T. flava* and *T. lineola*. Other Palestine records are Haifa, fresh 11–27.V.1920 (Hope Mus.), very worn 3.VI.1921, 21.V.1921, and Jerusalem 17.V.1922 (the last 3 by P.A.B.). Occurs nr. Beirut (V. my Coll.), Amasia (e.VI. Stgr.), and Samos, where Flight-Lieut. E. Betts took a worn specimen in early June 1920.

I have not enough material to express any opinion as to the variation of this species.

12. **Thymelicus acteon** Rott. subsp. **phoenix**, mihi.
(Pl. V, figs. 6, 7.)

Obthr., Lep. Comp., iv, p. 359. "Syriaca" in Staudinger's price-lists. Subsp. *phoenix*, in sequente descripta.

The Staudinger-Bang-Haas sale catalogues listed Syrian *T. acteon* as *syriaca*, but the name has never been validated and must fall, *syriaca* Tutt having been applied previously to the Syrian race of *A. flava*, a closely allied species fully validated and published in Brit. Lep., vol. viii, p. 107. Oberthür (*loc. cit.*) mentions the Beirut *acteon* as differing from those of Europe, but does not name or describe it. I have therefore decided to name this race "*phoenix*," *i.e.* "The Phoenician." It is found all along the Syrian coast-line, notably at Beirut and its immediate Hinterland at least as far as Jaffa. Mr. H. J. Turner (Trans. Ent. Soc. Lond. 1920, p. 206), has given the name *obsoleta-clara* to the race from Cyprus. The latter seems to me to be a transitional one between European *acteon* and *phoenix*, and in some cases to be indistinguishable from the latter. Tutt's types are now undiscoverable, and his remarks on the variation of *acteon* on pp. 118, 119 of his account of the species in vol. viii of British Lepidoptera give one the impression that he had no Syrian examples before him.

Description. ♂. Markedly larger than *acteon acteon*, the fore-wing being sometimes over 13 mm. in length. Upperside, all wings suffused with a brighter and heavier golden-brown scaling, the crescentic series of paler spots just outside the cell large, though less visible than in the typical form because of the brighter ground-colour, uniting with the paler orange-brown or golden-brown spot in the discal cell. The black margin of all wings, especially the hind-wings, much narrower than in *acteon* and much less suffused. The underside somewhat lighter. ♀. Still larger than typical ♀ of *acteon*; fore-wing reaching a length of 14·5 to 15 mm. Ground-colour and other characters as in the ♂, but the crescentic series of paler spots is more marked and reaches *SM*2 in half the examples examined.

Described from 12 ♂♂ and 8 ♀♀ from Beirut, Jemhur-Areya (1,000–1,500 ft.), and Hasmié in Lebanon, Nazareth, ♂ taken 11.V.1921, and Jenin, Galilee, ♀ 25.V.1922, the last two having been taken by Dr. Buxton. As types I have chosen a male from Beirut ex Zeller Coll., now in the

B.M., and a female also in the B.M. labelled "Beirut, A. H. Jessup."

Distribution and Dates. To the localities and dates given above I must add Haifa (von Kalchberg) nr. Jaffa, e.V. (Kneucker), Zikron Yakub, Coastal Plain, worn, 17.V.1921, and Jerusalem 12.V.1922 (the last two records by Dr. Buxton), Ludd and Tulkeram, abundant, V. (Hemming Coll.). It is apparently frequent at low and medium elevations in the foothills and on the Plateaux in many parts of Palestine.

13. **Chapra mathias** F. subsp. **mathias.**

Fab., Ent. S. Suppl., p. 433 (1798). "S. India."

Distribution and Dates. This species occurs locally in Palestine at low elevations. I have not many records of its occurrence. Seen nr. Jaffa, Aug. 1904 and Sept. 1907 in gardens (P.P.G.), Ludd 29.VII. and Beisan V. (Hemming Coll.), Abyssinian Village, Jordan Valley 6.VIII.1923 (Hemming Coll.). 4 ♂♂, 3 ♀♀ in Jordan Valley below Jericho (Gauckler), Wadi Fara 7.VIII.1923 (Hemming Coll.). It is not rare nr. Beirut and often abundant in Egypt. Occurs in Cyprus, Iraq and the Cilician Plain. In Egypt it appears to be double-brooded, the 1st Gen. appearing e.III. to e.V., the 2nd from b.VIII. to b.XI.

Variation. Not worth remark in Near Eastern specimens of this very constant species.

(Note.—*Baoris zelleri* Led., which occurs at Beirut and in Egypt and possibly Cyprus, should be looked for in Palestine.)

14. **Gegenes nostrodamus** subsp. **nostrodamus.**

Fab., Ent. Syst., p. 328 (1793). "Barbary."

Distribution and Dates. Der-el-Belah VII.1917, a few (P.P.G.), Haifa (Kalchbg.), possibly *lefebvrii*. Jordan Valley nr. Jericho VIII. IX. (Andrews), Jaffa Dist., Ludd 29.VII. and 4.VIII., Bethshemem, nr. Ludd VIII. with *lefebvrii* at both localities, Wadi Fara 7.VIII. (Hemming Coll.), Tiberias 29.VII. (Barraud).

It probably occurs in other Palestine localities. In my experience in Egypt it prefers watered (irrigated) ground, though it occurs in the desert as *C. mathias* does more occasionally. In Egypt it has at least two main broods, the 1st Gen. nr. Cairo appearing in IV. V. and the 2nd

abounding from e.VIII. to m.X. I have, however, taken fresh specimens in late VI., so there may be an intermediate generation.

Variation. ♂ are somewhat variable in Egypt. I have no material to describe its variation in Palestine.

15. **Gegenes lefebvrii** Rbr. subsp. **lefebvrii.**

Rambur, Cat. Lep. And., pp. 90, 91. "Andalusia."

Distribution and Dates. I have a single Transjordanian example before me, taken on 14.VIII.1923 at Wadi Sir by Mr. H. St. J. Philby. In the Hemming Coll. are 4 ♂ and 6 ♀ spees. taken at Ludd. in VII. and others from Ludd and Bethshemem VIII. and Bir Salem (B. Yakub) 22.VI.

It should be looked for in Palestine, since it occurs more commonly at Beirut e.III.–V. and e.VIII. than *nostrodamus*. I have taken it at Damascus in early IX.1910. For its distinction from *nostrodamus*, which to my mind is most obvious, see Obthr., Lep. Comp., vol. 5, Pl. LXIV, figs. 617–618*b* (*nostrodamus*), and figs. 619–620*b* (*lefebvrii*). My Beirut experience makes me rather doubtful whether Dr. Verity's theory that this species is single-brooded and that the female emerges before the male is applicable in its Beirut habitat.

RHOPALOCERA.

LYCAENIDAE.

16. **Strymon spini** Schiff. subsp. **melantho** Klug.

Klug, Symb. Phys., Pl. XL, figs. 10, 11. "Syria."

Distribution. Haifa (8.V.1921, P.A.B.). Not recorded by von Kalchberg in his local list. I have seen two or three examples taken near Ain Sinia between Jerusalem and Nablus in May 1918 in the collection of the Egyptian Ministry of Agriculture. Not recorded from Transjordania and very doubtfully indeed from Cyprus. Locally near Beirut and in Lebanon to 4,500 ft. Slopes of Mount Carmel 11–23.V.1920 (Barraud).

Dates. See above for Palestinian records. In Syria it appears in early May at low elevations and later at greater heights, where it may be taken in bad order as late as July.

17. **Nordmannia ilicis** Esp. subsp. **caudatula** Z.

Zeller, Isis, 1847, p. 6. "Makri, Patara," S.W. Asia Minor.

Distribution and Dates. v. Kalchbg. reports this subspecies with ab. *cerri* from Haifa. In the Lebanon locally at medium elevations, 3,000–4,000 ft. at Ain Zahalta, etc., and also at Bludan, Anti-Lebanon. Barraud took "*N. ilicis* f. *cerri*" in a bushy ravine below Mount Carmel 11–23.V.1920.

It presumably occurs in Palestine in May, which is its month of emergence in S. Greece and in some of its Lebanon localities. I found it in bad order at over 4,000 ft. at Bludan in early VII.

18. **Apharitis acamas** Kl. subsp. **acamas** and subsp. **egyptiaca** Riley.

Klug, Symb. Phys., Pl. XL, figs. 7, 9. "Syria and Arabia Felix." The nymotypical *acamas* is the Syrian race, but Klug figured a ♀ from Syria and a ♂ of the subsp. *bellatrix* Butler, which occurs on the Red Sea littoral of the Sudan. Subsp. *egyptiaca*, cf. Riley, Nov. Zool., xxxii, p. 88, 1925. "Mokattam Hills, Cairo."

Distribution and Dates. Apparently fairly widespread in Palestine. Haifa (v. Kalchbg.), Akka, 5 specs. 9.VI.1921 (P.A.B.), Kolonia nr. Jerusalem 21.VII. (Swinton), Jerusalem 23.V.1922 (P.A.B.). *Egyptiaca* occurs at Ludd, c.VI., 19.VII., 18.VIII. (Hemming Coll.). *Acamas acamas* occurs in the Jord. Vall. at Ghor-es-Safi, S.E. end of the D. Sea, 3.XII.1923 (Philby), and at Hasban (Heshbon) Transjordania 21.X.1923 (Philby). Frequent on the coast about Beirut and found on the lower slopes of Lebanon, Hermon, etc., but not at any great height. Very local and uncommon in Cyprus (subsp. *cypriaca* Riley). In Sinai, both north and south, apparently *acamas*. In Egypt in the deserts east of Cairo occurs the bright ochreous race, *egyptiaca* Riley. *A. acamas* seems to have at least two Gens., one at Beirut from IV.–VI., and another in VIII. IX. The Ghor-es-Safi date suggests a 3rd Gen.—perhaps continuous-broodedness in favourable areas.

Variation. Palestine examples resemble the Syrian. In each area a certain number of ♀♀ have rather heavy dark marking. *Egyptiaca* is of "a more vivid ochreous, the dark markings not so large." It shows a strong

tendency to develop a horseshoe-shaped mark on the costa of the hind-wing below "barely apparent in any other subsp." (Riley, *loc. cit.*).

19. **Virachola livia** Kl. subsp. **livia.**

Klug, Symb. Phys., Pl. XL, figs. 3, 4. "Between Keneh and Assuan, November."

Distribution and Dates. This species was discovered in Palestine by Mr. P. A. Buxton. It occurs at Rehoboth and elsewhere in the Hinterland of Jaffa, at Tulkeram, ♀, 29.III (Hemming Coll.), and probably near the foothills at Ramleh, where in 1918 I discovered pods of *Acacia farnesiana* which seemed to have been bored by the larva. For its possible origin as a Palestinian insect see Part I, 2, p. 34.

Mr. Buxton's examples mostly emerged from the pupa in the winter months, XI., XII. and I., but as he informs me that it attacks pomegranate in its larval stage in Palestine, it must have a late summer and autumn brood as in Egypt. I have taken it at Beirut in September. General in the non-desert parts of Egypt.

Variation. I have no proof that this species varies seasonally or geographically. Its individual variations in Egypt have been named and figured by me (Entomologist, May 1918).

(Note.—*Lycenaesthes amarah*, ♂, was taken by me at the end of V.1918 flying about trees of *Acacia leucophlaea*(?) with *A. jesous gamra*. Another was seen. This tropical (Ethiopian) species should be looked for in the Ghor-es-Safi and in the Jordan Valley in summer.)

20. **Iolaus (Epamera) jordanus** Stgr. subsp. **jordanus.**

Staudinger, Iris, x, pp. 153–155, Pl. V, fig. 5. "Jordan Valley."

Distribution. This very interesting species, which seems most closely related to the E. African *E. umbrosa*, was discovered by Herr Paulus in 1896. Mr. P. A. Buxton was informed by Mr. Aharoni, the well-known Jewish naturalist of Rehoboth, Palestine, that it occurred in the lower Wadi Fara, a deep defile running into the Jordan Valley from near Nablus, but had not been seen there of late years. It should, however, be rediscovered in one of

the many hot wadis which run into the Valley or in the Valley itself. Information concerning its food-plant and habits will be of great interest.

Date. e.VIII.–e.IX. Stgr.

21. **Lampides boeticus** L. subsp. **boeticus.**

Linn., Syst. Nat., ed. XII, p. 789. "Barbary" (Algeria).

Distribution. Occurs generally in Palestine, but is more frequent in the low ground and in or near cultivated country where pulse are grown than elsewhere. I have never found it so abundantly as in Egypt, where it is one of the commonest species. Occurs in Transjordania.

Dates. I have seen this species in good order in the Jordan Valley on 18.III.1921. In 1918 I picked up a worn female near Bir Yakub in March and heard of its being taken before Gaza in the same month. It appears to emerge occasionally during the winter and early spring months on the plains as in Egypt. In summer and autumn it is continuously brooded. I met with it in the dry steppe about Der el Belah in VIII.1917, and also in the oasis of Khan Yunus. Its food-plants are numerous; they include the ordinary pea (*P. sativum*), Lablaba (*Dolichos lablab*) and other cultivated Papilionaceae, as well as various wild vetches.

Variation. Except that ♀♀ of the winter and early spring broods are more often suffused with a bright metallic blue and that specimens taken in the driest and hottest months of the year are often extremely small, as in Egypt, this species does not vary markedly. I see no difference between specimens from Egypt, Syria and Palestine, and Greece which would justify any supposition that it shows any geographical variation in the Near East.

22. **Syntarucus telicanus** Lang. subsp. **telicanus.**

Lang., Verz., p. 47 (1789). "S. France."

Distribution. This species, which is abundant in Egypt, and also occurs in Cyprus in the subsp. *aegyptiaca* Beth.-Baker, is much less frequent in Syria and Palestine. From the latter country, indeed, it is only recorded from Haifa (von Kalchbg. Iris, X, Lep. Faun. Haifa), Wadi Rubin, 18.VII. and Ludd 29.VII (Hemming Coll.). It is doubtless

more widespread, at all events in the coastal plains. Not yet recorded from Transjordania.

Date. In Egypt there is a vernal emergence in IV.b.V., followed by a summer emergence in VI.–VII. From IX. to b.XII. there seems to be a continuous emergence. I have only taken *telicanus* in Syria, nr. Beirut and Damascus in September.

Variation. My Syrian examples are all *telicanus*. One finds the typical form in Egypt only as an aberration in late November and December.

23. **Azanus jesous** Guer. subsp. **gamra** Led.

gamra Lederer, Z. B. Wien, 1855, p. 189, Pl. I, fig. 3. "Beirut."

Distribution and Dates. An Ethiopian or Indo-Ethiopian species occurring in Palestine, often frequently, in the Coastal Plain and also in the Jordan Valley. Also at Beirut and Akaba (Aqaba), at which latter locality Mr. Philby took it 5.I.1924, and I found it in some numbers 28–31.V.1918 flying with *Lycaenesthes amarah*. Near Beirut it occurs from April (worn in early May, Mrs. Nicholl), July (P.P.G.) and September. Palestine records and dates before me are Jordan Valley at Beisan 4.IV.1922, nr. Lake Huleh 24.V. 1922, Tabagha 2.VII.1921, Coastal Plain, Akka 8–10.VI. 1921, both sexes, Tulkeram, worn, 10.VI.1922, Ludd VII., and 18.VIII.1923; Haifa (v. Kalchbg.) 3.VI., Jaffa, Kakun. 14.VI.1922, Wadi el Hawaris, m.VI.1922 (all except Haifa records from Buxton and Hemming Colls.). Nazareth 30.VI.1921, the highest locality which I know of (Buxton), Plain of Jenin 3.VII.1901 (Miss Fountaine, in B.M.), Gaza (Hope Mus.). I have always seen this species flying near Acacia bushes, *A. leucophlaea* or *A. seyyal*, and believe that its larva feeds on them.

Variation. An examination of a large number of examples from Africa, Beirut and Arabia in the B.M. leads me to believe that Seitz's separation of the Asiatic *gamra* from the African *jesous* is perhaps justified. *Gamra* is somewhat darker in colour and more thickly scaled, so that the dark markings of the underside are less visible on the upperside. The species is rather variable in size and, among the ♀♀, in depth of ground-colour on the upperside of the fore-wings, which are sometimes almost uniformly brown, while in other cases a pale discoidal patch covers a considerable area

on each side of the spot at the distal end of the discoidal cell. The ground-colour of the underside and the size and intensity of the spotting thereon are variable in both sexes, but I cannot satisfy myself that these differences are more frequent in one generation than in another.

24. **Tarucus mediterraneae** Beth.-Bak. subsp. **mediterraneae.**

Bethune-Baker, Trans. Ent. Soc. Lond., 1917, pp. 281–283, Pl. XIV, figs. 7, 7*a*. "Alexandria."

Distribution and Dates. This species is apparently somewhat more local than *balcanica* in Palestine, but to judge from Dr. Buxton's records is fairly widely distributed. I have taken it near Umm el Kilab on the political border of Egypt in late August 1918, and near Jericho in March. Dr. Buxton's specimens include examples from Tabgha 6.IV., Tiberias IV., Beisan and Jericho at various dates from III. to VIII. A fine race of large size occurs at Akaba in late May (P.P.G.) and the species occurs throughout Egypt. It also occurs locally in Algeria.

Variation. This is a rather variable species. The upperside of the males seems to be of a lighter and more rosy-violet ground-colour in summer specimens than in those taken up to the end of May. The size of the black markings on the underside varies, as does the clearness of their outline, some specimens having the bands much more suffused than others. One specimen from Tiberias has an underside which rather resembles that of *theophrastus* F., but an examination of the male genitalia shows that it is *mediterraneae*. One example from Tabagha is as large and bright as those which I have taken at Akaba. This local race may prove to deserve a name. It is larger than the average Egyptian *mediterraneae*, the male is brightly coloured, the ♀♀ have well-developed white spots and bands of spots on the upperside of both wings, and the dark markings of the underside in both sexes are clearly defined without any marginal suffusion. The females from Jericho in Dr. Buxton's collection seem to be *mediterraneae*, but I should like to point out that while *balcanica* ♀♀s in my experience have much less white marking than most of those of *mediterraneae*, the latter are on occasion as dark on the upperside as *balcanica* from Syria and Palestine. I have bred *mediterraneae* ♀♀ from Egypt, from Abukir, for example, which I cannot distinguish with certainty

from those of *balcanica*, the pattern of the underside being in my opinion no safe guide in the more southern habitats of the last-mentioned species.

Food-plant. I have bred *T. mediterraneae* in Egypt from larvae found on the cultivated *Zizyphus* or "Nabb," which I believe to be *Z. lotus*.

25. Tarucus balcanica Fr. subsp. balcanica.

Freyer, v, p. 63, Pl. 421, figs. 1, 2. "Turkey."

Distribution and Dates. Widespread on the lower ground, occurring both in the Jordan Valley and in the steppe south of Gaza, but apparently absent from or rare in some of the higher parts of the Plateaux. In 3 Gens. the first appearing m.e.III. at Jericho. The last generation appeared in September at Umm el Kilab, S. of Gaza, in 1918, and lasted for about three weeks. I bred the species from larvae found on bushes of *Zizyphus spina-christi*.

I have seen no specimens from Transjordania. It is sometimes very abundant, *e.g.* Tiberias, e.VI. (Fountaine), but confined to the neighbourhood of its food-plant and may therefore be overlooked.

Variation. Examples taken by me at Jericho, 19–21.III. 1921, are heavily suffused with a darker violet blue than is usual in this species and have very little dark scaling on the tornus on the upperside of the fore-wings. This may be a vernal race, the summer specimens in my possession being lighter and apparently less heavily scaled, so that the dark markings of the underside show through the wings. The dark suffusion about the cell apex on the upperside of the fore-wings varies in extent. The ♀♀ can sometimes be distinguished from those of *T. mediterraneae* by the reduction of the white median and submarginal marking on the hind-wings (upperside) and its often complete disappearance on the upperside fore-wings.

Tarucus theophrastus F. subsp. theophrastus.

Fabricius, Ent. Syst., p. 281. "Morocco."

Although this species appears as from Palestine in the Staudinger sale-catalogues, all the "*theophrastus*" from Palestine which I have seen are *mediterraneae*. This species quite possibly occurs in Palestine, but proof is required of its occurrence before it can be included in the local list.

26. **Chilades galba** Led. subsp. **galba.**

Lederer, Z.B.V. Wien, 1855, p. 190, Pl. I, fig. 4. "Beirut."

Distribution and Dates. This pretty little Lycaenid has so far not been discovered outside Iraq, Syria-Palestine and Cyprus, unless *C. phiala* from Transcaucasia proves to be identical with it or a subspecies. First described from Beirut, where Zach collected a few specimens for Lederer, it was for long not taken and was even confused with the common *Zizera karsandra* Moore, by Elwes and apparently by Seitz. Miss Fountaine, so to speak, rediscovered it in the north of Palestine in 1901, and it has subsequently been found to have a wide distribution in the southern portion of the Near East, although it does not seem to occur in Egypt, and its food-plant in Iraq (*Acacia leucophlaea*) has been discovered and its larva described. It is uncertain whether the species has one long-continued generation in Palestine commencing in late V. and continuing to the autumn, as in Cyprus and Iraq, or is everywhere double-brooded. It occurs in the Jordan Valley and the Plains, but there is also a record for the lower part of the Plateau (Merj Sanur, Samaria and Wadi el Hawaris, Samaria 16.VI. 1921). Other localities and dates are Ludd VII.1923 and m. VIII., Abyssinian village, Jordan Valley b. VIII. (Hemming Coll.), Ain Malih, Jordan Valley 28.IX.1923 (Philby), probably a 2nd Gen.; Beisan ♂ 25.VII.1922 and ♀ 10.VII., Tabagha 2.VII.1921, nr. Lake Huleh 21. V.22, Jericho VI. and 15.VII., Akka 10 and 28.VI.1921 (Hemming and Buxton Colls.). Abundant on plain N. of Akka with *A. jesous gamra*, 21.VII. (Barraud, who calls the species *phiala*); Plain of Jenin (end VI. Ftne.), Gaza dist. (Hope Mus.), Azraq, Transjordania 7.X.1923 (Philby), 2nd Gen. if not 3rd, certainly double-brooded here.

Variation. I have not been able to detect any racial differences between specimens from Iraq, Palestine and Cyprus.

Individual variation in size is fairly considerable, ranging from 9·5 mm. to 11 mm. in the ♀♀ (length of f.w.) and 9·0 mm. to 10 mm. in the ♂♂. A very small ♂ from Ain Malih (nr. the Allenby Bridge over the Jordan on the Transjordanian side) has bright deep violet ground and very broad dark margins, 28.IX.1923 (Philby).

27. **Chilades trochilus** Frr. subsp. **trochilus.**

Freyer, 440, i, v, p. 88, 1847. "Turkey in Europe."

Distribution and Dates. This little species probably has a wider range in Palestine than would appear from the small number of localities which I can give. These are Tabagha, Jordan Valley 6.IV. and Merj Sanur nr. Samaria 16.VI. (P.A.B.), Haifa Dist. (v. Kalchbg.), Tulkeram b.XI. to 4.XII. (Hemming Coll.), Nazareth 30.VI.1921 (P.A.B.), nr. Jerusalem, 30.VI. and 18.VIII. (Swinton), Amman 30.VIII. (Hemming Coll.), Wadi Sir, Azraq and Fuheis, Transjordania (Philby). These last are very small examples, obviously of a 2nd or 3rd Gen. and were taken 13.VIII. at Wadi Sir, 14.VIII. at Fuheis and 7.X. at Azraq, which is 70 miles W. of Amman. Abundant nr. Beirut, less frequent at higher levels in the Lebanon, widespread in Cyprus, locally in Asia Minor, Macedonia, Greece. Locally frequent in Egypt. At Akaba e.V.1918 (P.P.G.). Has an extensive tropical range reaching N. Australia.

Variation. Ruhl-Heyne describes the Egyptian race as having wider reddish-orange submarginal markings on the upperside hind-wings. Whether this is really so or is due to the fact that the *C. trochilus* of the early summer generation taken there are on an average of larger size than those from Syria, etc., and therefore have larger reddish-orange markings I cannot yet determine. The *C. trochilus* which emerge in Egypt in X.XI. are certainly very much smaller than those taken in V.VI. This is also the case, though less markedly so, with Syrian specimens.

28. **Plebeius medon** Esp. subsp. or seas. form **calida** Bell.

Bellier, Ann. Soc. Fr., 1862, p. 615, Pl. XIV, fig. 6. "Corsica."

Distribution. Although frequent enough in Lebanon *P. medon* is decidedly rare in Palestine. Neither Swinton nor v. Kalchbg. mention it in their local lists, and there are only four specimens in Dr. Buxton's Coll., viz. from Wadi Kabala 10 m. W. of Jerusalem, two with very pale undersides 2.VI.1922, Nebi Samwil, *calida* 5.VI.1922, Nazareth apparently *pallidefulva* Vrty., 30.VI.1921.

Dates. See above for Palestine. In Syria there are three generations emerging in the mountains from 3,000–5,000 ft. in late April, July and September respectively.

Variation. The majority of Syrian *medon* which I have seen were *calida* and belonged to the 2nd or 3rd Gen. The only 1st Gen. examples which I have from Beirut might have come from Macedonia or Constantinople.

But in S. Cilicia (Shar Deresy) occurs a race with very pale underside. At Bludan 3rd Gen. examples taken in September 1907 and 1910 were much paler than average *calida* and seem to be Verity's *pallidefulva* (Ent. Rec., xxxii, pp. 149, 150). On the other hand, 2nd Gen. *medon* from the sandstone at Ain Zahalta (Bludan is on limestone) had very dark and richly coloured undersides. I suspect that there are two races of *medon* in Syria and perhaps Palestine; one with very pale underside in the 1st Gen. and paler underside than *calida* in the 2nd and 3rd Gens., occurring on limestone, ? *infracandida* Vrty., and also, *calida*, occurring elsewhere, *e.g.* on alluvial at Beirut and sandstone at Ain Zahalta. Both forms seem present in Palestine, but much more material is required before it can be said that the pale form is racial and not an occasional aberration. If it is racial, its 2nd and 3rd Gens. may be *pallidefulva* Vrty.

I may conclude by saying that I have never myself taken *infracandida* in Asia Minor, Syria or Greece, but only forms agreeing with the descriptions of *ornata* or *subornata*. I consequently feel that Dr. Verity's suggestion (Ent. Rec., xxxii, pp. 147, 148) that *infracandida* is the "prevailing" form in Asia Minor and Syria as the 1st Gen. of *P. medon* is hardly justified by facts.

29. **Plebeius sephyrus** Friv. nova subsp. **philbyi**, mihi.
(Plate V, fig. 1 ♂ and 2 ♀.)

In Rebel and Daub's contribution to A. Kneucker's "Zoologische Ergebnisse zweier . . . durch die Sinaihalbinsel unternommener botanischer Studienreisen," published in the Verh. Natw. Ver, Karls., 1907–1908, with a continuation in 1909, mention is made of the capture of "*P. sephyrus zephyrinus*" in the Southern Sinai.

It is possible that this form of *sephyrus* is the new subsp. *philbyi*, which in some respects is nearer to *zephyrinus* in its underside colouring and marking than to the Syrian *nicholli*.

Distribution and Dates. In Transjordania, where it was captured by Mr. H. St. J. Philby at Petra between March 25 and April 3, 1923 (2 ♂♂ and 2 ♀♀), and at Zarqa, N. of Amman (one ♂) on April 24 of the same year. In the Hemming Coll. is a magnificent ♀ taken at Tel Khuweilfa, N.W. of Beersheba, 17.IV.1923.

Variation. As will be seen from the following descrip-

tion, two forms of the ♀ were taken. I do not propose to give a name to either as yet, but to distinguish them as female form A and female form B, because until more material is to hand it is quite impossible to say which of these two forms is the normal ♀ of *philbyi*, and it would be most undesirable to make any such assumption inferentially by describing one or other as the normal ♀ and thus risking the description of typical ♀ *philbyi* as a ♀ form, *i.e.* aberration, and vice versa.

Description. Upperside. Generally resembles *P. sephyrus nicholli* Elwes, but the wings are more rounded and shorter, length of fore-wing varying from 13·5 mm. to 14·0 mm. in the specimens described, while in no specimens of subspecies *nicholli* which I have examined does it fall short of 14 mm., and the usual length in that subspecies is from 15 mm. to 16 mm. Fringes white, termen rather broadly black, ground-colour lustrous "light violet" (Ridgway, "Colour Standards," Pl. X, 59*b*). The marginal and submarginal marking of the upperside of the hind-wings varies. In subsp. *nicholli* reddish-orange or pinkish-orange submarginal spots are generally present in varying numbers and size in the interspaces from the tornus to interspace 3 inclusive. These sometimes surmount black marginal spots barely separated by violet scaling from the termen. Of the three ♂ examples of subspecies *philbyi* under consideration one from Zarqa 24.IV. has a reddish-orange submarginal spot in interspace 2, traces of a doubled spot in interspace 3, and on the tornus and nearer the termen a row of black spots, the largest and most clearly defined being in interspace 6, and the next largest and next clearest being in interspace 2. Another example has a circular black submarginal spot in interspace 2 and no other black or orange spots. Another (Petra 25.III.) has no spots, orange or black, at all on the upperside of the hind-wing, except a marginal spot in interspace 6.

Underside. In general the underside in both sexes differs very greatly from that of *P. sephyrus nicholli*, in which subspecies the greyish-fawn or greyish ash-coloured ground is largely mixed with white scales, with the result that the black spots of the submarginal bands, the discoidal spots on both wings and the basal row on the hind-wings, though ringed with white, do not stand out from the ground-colour so prominently as in *philbyi*. In the latter the ground-colour is a lustrous "mouse grey" (Ridgway,

"Colour Standards," Pl. LI, 15''''), against which the white rings round the black spots and the spots themselves stand out most prominently, and the more so seeing that these spots are much larger relatively than in *nicholli*. Only the rings round these spots and the distal marginal area for about 1 mm. basad from the termen are pure white. The reddish-orange submarginal spots on the fore-wings and the reddish-orange scaling which fills the band of submarginal chevrons on the hind-wings are of a deeper and glossier colour than in *nicholli*. The size of these spots varies. In the Zarqa example they fill all the interspaces on the fore-wing from and including interspace 2 to interspace 6 for a depth of 1·5 mm. In the others they are smaller. The Zarqa example has a small white-encircled black basal spot on each fore-wing. The greenish-blue scaling which is found on the bases of all wings in *nicholli* is less abundant in *philbyi* and of a more metallic green lustre. Described from 2 ♂♂ taken at Petra 25.III.1923 and 1 ♂ taken at Zarqa 20.IV.1923.

♀. Form A. *Upperside.* Wings very rounded, length of fore-wing 17 mm. Ground-colour deep clear brown suffused with light violet-blue of nearly the same colour as the male, over somewhat more than one-third of the fore-wing from the base, the suffusion covering the posterior half of the discoidal cell and about two-thirds of the hind-wing. There is a submarginal row on fore- and hind-wings of pinkish-orange almost flame-coloured spots. On the hind-wing these begin on the tornus, after which there is a gap, then a large flame-coloured spot in interspace 2, a smaller one in 3 and traces of a spot in 4. On the fore-wing there is a reddish spot in interspace 2 and a smaller one in interspace 3. On all wings from tornus to and including interspace 6 on the fore-wings and from tornus to and including interspace 6 on the hind-wings there is a marginal row of black spots easily distinguishable against the ground-colour. In the sub-apical area of the fore-wings are grey lightenings such as are so frequent in British "blue" ♀♀ of *P. icarus* of the 1st Gen. Described from a ♀ taken at Petra 28.III.1923.

Underside. As in the male, the black spots, white rings round them, and lustrous deep mouse-grey ground-colour being equally pronounced. There are traces of greenish-silver scaling on the marginal black spots of the hind-wing in interspaces 1*c* and 2.

♀. Form B. *Upperside.* Much smaller than A, the fore-wings not exceeding 13·9 mm. in length. Ground-colour a deep brown somewhat resembling that of dark *P. medon*, but duller and colder. There are slight traces of light violet blue scaling at the bases of all wings, and small reddish-orange submarginal spots at the tornus of the hind-wings and in interspaces 2 and 3 thereof, also in interspaces 2 and 3 of the fore-wings.

Underside. Black spots and linear chevrons more prominent than in any other specimen examined. Ground-colour "deep mouse-grey" (Ridgway, "Colour Standards," Pl. LI). Traces of greenish-silver scaling on marginal black spots of hind-wings in interspaces 1*c* and 2. Described from a ♀ taken at Petra 3.IV.1923. I have named this fine race of *sephyrus* '*philbyi*' after its captor.

(Note.—Since describing the two forms of the ♀ I have seen a third form larger even than A, with almost complete rows of reddish-orange submarginal spots, large in size and very rectangular in shape, on both sides of all wings. This specimen is in the Hemming Coll., and was taken at Tel Khuweilfa, N.W. of Beersheba, on 17.IV.1923.)

30. **Plebeius (Polyommatus) loewii** Z. subsp. **gigas** Stgr.

Stgr., Cat., ii, p. 10, 1870. "Mt. Tmolus, Lydia," *i.e.* Boz Dagh, E. of Smyrna.

Distribution. *P. loewii* was discovered by Dr. Loew in S.W. Asia Minor and named after him by Zeller; subspecies *gigas* occurs in the Wilderness of Judaea, *i.e.* the very dry mountain steppe between Jerusalem and the Jordan Valley, reaching the Valley itself at the point near Jericho where the Wadi Kelt issues from its gorge into the plain. I have seen no specimens from Transjordania, but should expect it to occur there. In Syria proper it occurs near Damascus at about 3,500 ft. and nr. Baalbek; also on the Lebanon range at about 6,000–7,000 ft. around the Cedars on the Jebel Zahalta above Ain Zahalta. It also occurs in Cilicia. An Egyptian race with a blue suffused female form occurs locally and not too commonly in the desert east of Cairo and Heluan. It has been named *johannae* by Andres.

Dates. As in Egypt this species emerges in April in its warmest localities. The following are Palestine dates: 6 m. E. of Jerusalem 12.V.1923, 10 m. E. of Jerusalem

♂ ♀ 17.IV.1922, between Hebron and Engeddi ♀, worn, 19.V.1923. Wadi Kelt 9.IV.1923 fresh ♂♂, 18.IV. worn ♂♂ (all P.A.B.).

In Syria Miss Fountaine took it early in May above Damascus, but it was already going over on May 8. At its highest point so far discovered in Syria, viz. the Ain Zahalta Cedars, the males first appeared about 20.VII., the females following at the end of the month and being mostly still fresh on August 10, 1907. The typical form first appears in Asia Minor in e.V. and VI. It appears to be single-brooded.

Variation. Subspecies *gigas* is much larger than the typical form, though Staudinger's description of it as "fere duplo major" is often an exaggeration. It is perhaps the most brilliant of all the Palaearctic "blues," being of a clear bright metallic sky-blue without any greenish admixture, of a somewhat lighter and purer tone than *P. thetis*. The ground-colour of the males of the typical form, *loewii loewii* is more violet. In the ♀ of *gigas* the double submarginal row of greyish-white spots varies in the size of the spots and in the amount of dark scaling which, mixed with the white, especially of the inner row, gives it a greyish appearance. The size of the reddish-orange spot near the anal angle of hind-wings also varies. The ground-colour of the ♀ varies somewhat in intensity on both sides of the wings. That of the ♂ underside varies but little. The ♂ is usually larger than the ♀. The largest ♂ which I have seen comes from 10 m. east of Jerusalem. The length of the fore-wing in this specimen is 20·25 mm., and I have seen others little smaller. I have seen no Syrian or Palestinian ♀ with a fore-wing exceeding 18 mm. in length.

31. **Polyommatus icarus** v. Rott. subsp. **zelleri** Verity.

Verity, Ent. Rec., xxxii, pp. 43, 44. "Florence."

Distribution and Dates. Occurs throughout Palestine, though it becomes rare towards the Egyptian border near Rafa. Even so I have taken it in VIII. IX. near Umm el Kilab, and specimens were taken by Major Austen at Der el Belah only a few miles further north on 8 and 29.IV.1917. It occurs in the Jordan Valley, where I found it fairly common locally nr. Jericho in the third week of March 1921. There are examples from many localities in Trans-jordania among Mr. Philby's captures, the earliest dated

Petra 30.III. (rather a small one); the latest examples which are of much the same type as the 1st Gen., having been taken at Ain Sara 26.XI. At Haifa it first appeared in 1921 on March 10. It appears to me to have two broods, the second divided by the summer pause, from March or April, according to the locality, to September, and in favourable localities a 3rd Gen. resembling the 1st in its later part. In Turkey (Constantinople Dist.), where it appears in early May and in fine autumn seasons may be taken in small numbers but in good order in early November, it seems to have two main broods and a partial 3rd Gen.

Variation. In Syria and Palestine a considerable minority of the examples of each generation, especially the 2nd, have extremely pale undersides, which in the ♂ are sometimes of a clear white ground-colour; I have taken some beautiful specimens of this form at Bir Yakub in March 1918. Others come from Zarqa, Transjordania 25.VII.1922 (Philby), Nazareth 11.V.1921 and 30.VI.1921, and nr. Jerusalem 12.V.1922. The blue-green scaling near the bases of all wings is strongly marked in the Palestine and Transjordanian 1st Gen. *icarus*, but disappears almost completely or completely in the 2nd Gen. specimens to reappear in those taken at the very end of the autumn. ♀♀ suffused to a greater or less extent with violet-blue are not infrequent among the 1st Gen. specimens. I have taken these at Jericho in March and at Bir Yakub (Coastal Plain) in the same month. A very fine blue-suffused ♀ from near Gaza is in the Hope Museum, Oxford. Those of the 2nd Gen. seldom have the slightest trace of blue, but a ♀ perhaps of the 3rd Gen., though taken at so hot a locality as Jericho on 7.X. by Dr. Buxton, is fairly extensively suffused with violet. The abs. *tripuncta*, *candiope*, *arcuata*, etc., all occur, and one finds here as elsewhere a certain number of dwarfs no larger than fair-sized *Cupido minimus* among specimens of the 2nd Gen.

In Syria there are two races of *P. icarus*, viz. *P. icarus zelleri* and a certainly single-brooded form which occurs at great heights on the Lebanon (6,000–10,000 ft.), which I hope to describe on another occasion.

(Note.—Among Dr. Buxton's specimens of *P. icarus* taken at Nazareth in June is one which agrees with M. Culot's description of *P. lucia* from Beirut, in Bull. Soc. Lep. Gen., 1905, p. 68, Plate I, figs. 6–8, but does not resemble the figures, which he admits are unsatisfactory.

It resembles a small bright-blue *P. icarus* ♂, but differs from any other of the Syro-Palestinian *icarus* which I have seen in its extremely rounded fore-wings. There is a well-marked sub-marginal spot in area 2, upperside hind-wings, less well-marked spots in areas 1*a*, 1*b* and 3, and quite a large marginal spot in area 6. This last feature is found in a specimen of *P. icarus* from Yozgad, Asia Minor, in the B.M., and in a ♂ example of *P. lucia* which M. Culot very kindly sent me.

Later (Oct. 14, 1915) M. Courvoisier informed the Lepidopterological Society of Geneva that an examination of the androconia of *P. lucia* induced him to believe that it was a species distinct from *P. icarus*. On the same occasion (see Bull. Soc. Lep. Gen., vol. iii, Proc. pp. 53, 54) M. Culot withdrew the name *lucia* as preoccupied and substituted *lucetta* for it. Unfortunately M. Courvoisier does not seem to have published the reasons which induced him to separate *lucia* from *icarus*, beyond the bare statement that the androconia were different. In the case of Dr. Buxton's Nazareth specimen the genitalia are markedly different from those of normal *P. icarus*. (See Plate IV, fig. 1.) The Yozgad specimen and M. Culot's *lucetta* on examination of the male appendages prove to be *P. icarus*. Whether all M. Culot's *lucetta* are like this specimen I cannot say, and the question of the specific identity of this Palestinian specimen must remain unsolved until more material can be obtained. It is, of course, possible that the Nazareth insect is simply an example of extreme individual variation of the ♂ genitalia.)

32. **Zizera karsandra** Moore (**lysimon** auctorum) subsp. **karsandra.**

Moore, Proc. Zool. Soc. Lond., 1865, p. 505, Pl. XXXI, fig. 7. "Plains of N.W. India."

Distribution and Dates. See Part I, 2, pp. 30, 34, for a theory as to the cause of the occurrence of this Indian species in Egypt, Syria-Palestine, Iraq, Asia Minor and Cyprus. Widespread in the Nile Delta, it is much less abundant in Syria and Palestine. I have taken it at, or seen specimens from Umm el Kilab (worn) XI.1917, Khan Yunus and Der el Belah VIII.IX.1917, Gaza III.–V. (Hope Mus.), Bir Salem (B. Yakub) III. 1918, Ludd VI.VII., and Surafend II.XII. (Hemming Coll.), Jericho, m.III.1922

and 30.IX., and 7.X. (P.A.B.), Beisan 11.VI.1922 (P.A.B.). Miss Fountaine found it in the Huleh Plain e.VI., and v. Kalchbg. reports it from Haifa. In Transjordania it occurs at Ain Sara 26.XI.1923, and Mr. Philby took a good series of both sexes at Zarqa 25–28.VII. He also found it in the Ghor-es-Safi 3.XII.1923 (Philby). Kneucker reports it (as *lysimon*) from the Sinai Peninsula.

The above dates suggest three broods at least. In Egypt it appears to be almost continuously brooded from III. to XI., and occasional fresh specimens may be picked up in the intervening months.

Variation. Blue-suffused ♀♀ are not infrequent in Egypt among those captured in the colder months, but are rare or absent in the hotter and drier period of the year. I have seen a "blue" ♀ from Jaffa. As a rule the smallest examples are those taken in the summer and early autumn. Examples with obsolescent spotting on the underside, especially of the hind-wings and with striate spots in the submarginal row on the underside fore-wings, occur as among other Lycaenid species.

33. **Turania baton** Berg. subsp. **baton** Berg.
?subsp. **clara,** Chr.
nova subsp. **nabataeus,** mihi. (Plate V, fig. 5 ♂.)

Bergstrasser, Nom., Pl. 60, figs. 6–8, ii, p. 18 (1779); Christoph, Mem. Rom., iii, p. 51, and Staudinger, Cat., p. 81, 1901. "Syria, Kurdistan, Tura, Fergana mer., etc."

With regard to the above, *clara* seems to have been originally a MS. name which Christoph quoted without giving any description, but Staudinger validated the name in his Catalogue of 1901 with the brief description "mas supra subcaeruleus sive albo-caeruleus."

As a matter of fact, the difference between Syrian and S. European *baton baton*, not *baton panoptes*, lies not so much in the colour of the upperside, a variable quantity, as in the large proportion of males among the former which have a very pale, almost white, ground-colour on the *underside* of all wings. These pale *baton* appear to be in majority in Syria, and, as far as I can judge from scanty material, in Palestine and Cyprus. At Constantinople the underside is of an ash colour which is sometimes mixed with

yellowish, and males with white undersides are always rare, though when the underside is ash-coloured there is often a sufficiently large proportion of white scales to give a pale bluish effect. Again, while the underside of nymotypical *baton* females is usually darker than that of the males, the Syrian and Turkestan females are often as light as the other sex. I cannot myself see any marked difference in the ground-colour of the uppersides of some of my Syrian *baton* and a number of males from Constantinople, and I should be inclined to describe the former as *transitus ad clara* if it were not for their very pale undersides, a character strangely neglected by Staudinger in his description of *clara*.

Subspecies *nabataeus*, mihi.

Description. A small race closest to the North African *abencerragus* Pier. (Ann. Soc. France, 1837, p. 21, "*Argus abencerragus*," described from a female from "Oran"), Pl. I, fig. 7, shows a male the upperside of which differs in no important particular from nymotypical *baton*, though the underside is markedly different. *Nabataeus* ♂♂ differ from *abencerragus* ♂♂ in the following respects: —

1. The ground-colour is deeper, nearly black, on the upperside, with less blue suffusion on the basal two-thirds of the wings. The ground-colour is sufficiently dark to make the marginal black spots on the hind-wings almost or quite invisible. There is little or no trace of the blue or bluish-white submarginal chevrons surmounting these spots which are so marked in *abencerragus*. In fresh specimens the fringes of the fore-wings (upperside) are heavily chequered, white and black, these markings being apparently relatively larger in *nabataeus*.
2. On the underside the differences are more marked. The ground-colour is deep ash brown, darker than in *abencerragus*, so that the black white-annulated spots stand out more strikingly. These spots are larger as a rule on the hind-wings of *nabataeus* than in *abencarragus*, which usually has rather small spotting on the underside of the hind-wings in both sexes. The discal row of spots on the underside of the fore-wings is relatively much larger than in *abencarragus*. Four out of five males show traces of yellowish or yellowish-orange scaling between the marginal black spots and the

submarginal chevrons on the underside of the hind-wings, a character also found in *abencerragus* though apparently rarely. Described from five ♂♂ taken at Petra between 16.III. and 28.III.1923 and on 26.III.1924 by Mr. H. St. J. Philby. Two males taken respectively at Salt 18.IV.1923 and Zarqa 25.VII.1923 (the latter obviously of the 2nd Gen.) by the same captor appear to be transitional between *nabataeus* and *baton*, more especially the Salt specimen. Types in B.M.

The following is a description of the only female *nabataeus* taken at Petra 4.IV.1924. Upperside dull brownish black, fringes of the fore-wings not chequered but clouded with brown. Underside of a clear brown ground-colour with heavy spotting; the fringes of the fore-wings heavily clouded along three-quarters of the outer margin from the anal angle with dark brown. The termen strongly marked in black on all wings; the submarginal row of spots distal to the discal row on the fore-wings forming a continuous band. The row of black submarginal chevrons on the underside of the hind-wings continuous for the greater part of its length and very strongly marked. There are faint traces of yellowish scaling on its distal side. Of two other females from Transjordania taken at Salt 18.IV.1923 and at Rusaifa 8.IV.1923 by Mr. Philby, the former is simply a dark specimen of *baton*, the latter, which has a brownish-grey and not a pale ash-coloured underside and has the fringes far more heavily chequered than the Salt specimen, seems a transitional form between *nabataeus* and *baton*. More material, however, is required than a single perhaps aberrant female before the above description can be taken as applicable to the female of *nabataeus* in general. The specimen under consideration is in the B.M.

Distribution. For Transjordanian records see above. In Palestine *T. baton* appears to be local. I have taken single fresh males at Haifa 8.III.1921 and Kolonia nr. Jerusalem on 31.III. In the Hemming Coll. are examples from Ludd 8.VII., Tulkeram 9.V. and Nablus IV. In Mr. Buxton's Coll. are worn examples from Nazareth, a ♂ dated 23.V.22 and a ♀ dated 30.VI.21, the latter possibly of the 2nd Gen. It is widespread in Syria, but seldom occurs frequently. Sometimes locally frequent in Cyprus. In Egypt (Maryut Steppe) occurs the subspecies *abencerragus*.

Dates. See above. In Asia Minor (Constantinople Dist., Bithynia, etc.) there would seem to be a long-drawn-out brood from late April to the end of June, followed by a 2nd Gen. emerging after the summer pause, in early VIII. at Constantinople.

Variation. See above for Transjordanian examples. Speaking generally 2nd Gen. specimens are smaller than vernal *baton*, and this rule may be expected to hold good in the case of the Palestine race.

34. **Scolitantides bavius** Evers. subsp. ? **fatma** Obthr.

Oberthür, Et. xiii (1890), p. 19, Pl. VII, figs. 50, 51. "Jebel Aures, Algeria."

Distribution. My authority for including this species in the Palestine list is von Kalchberg, whose insects from Haifa were identified and named by Dr. Staudinger. There can therefore be no doubt of the occurrence of *S. bavius* on Mt. Carmel. It should be looked for in April or early May in the vicinity of *Salvia*, on which its larva feeds, near Constantinople, where the ♀ oviposits on *S. acutifolia*. I know of no Lebanon records of any form of *bavius*, but it has been taken in the S.E. of Cilicia or the extreme N. of Syria at Shar Deresy (Leech Coll. in B.M.) and in the Amanus (Elma Dagh) above Alexandretta (*teste* Rebel, captured by Herr Tölg b.VI.1914), apparently at a considerable height above sea-level.

Variation. Dr. Staudinger in his Catalogue, Ed. III, 1901, refers to the Syrian *bavius* under the Algerian subsp. *fatma*. One would be glad to know more of the Syrian, and especially the Palestinian *bavius*, since the form which occurs near Constantinople and at Gallipoli is not the *bavius* of the S. Russian steppes (if examples of the latter in the B.M. are typical), and given the wide, if discontinuous distribution of this local species—Algeria in Jebel Aures, Haifa, N. Syria, Cilicia, Brusa, Amasia, Constantinople Dist. (Asia), Gallipoli Pen., Hungary (very local), S. Russia and parts of Central Asia—it has probably a number of local races.

35. **Glaucopsyche cyllarus** Rott. subsp. **aeruginosa** Stgr.

Staudinger, Stett. Ent. Z., 1881, p. 285. "Ala Tau."
A single aberrant specimen is recorded by von Kalchberg

from Haifa. I include it in the Palestine list, since subsp. *aeruginosa* is not uncommon though somewhat local at moderate elevations on the west slope of Lebanon and occurs near sea-level at Beirut. Should be looked for in early April in N. Palestine. *G. cyllarus* does not occur in Cyprus, where its place is taken by its congener *G. paphos* Chapman, rather a local species occurring both in the Troodos and Kyrenia Mts.

36. **Heodes thersamon** subsp. **thersamon** Esp., seasonal form (gen. aest.) **omphale** Klug, and f. **militaris** mihi.

Esper, lxxxix, 6 (1784). "Sarepta." Klug, Symb. Phys., Pl. XL, figs. 12–14. "Syria."

Distribution and Dates. Apparently absent from the steppe south of Gaza and from Jordan Valley near Jericho, but otherwise generally distributed and locally frequent. The 1st Gen. appears in March in the warmer localities, *e.g.* at Bir Yakub in the plain near Ramleh e.III.1918. Tulkeram e.III. b.IV., and may be taken as late as in May on the high ground. Swinton gives the following dates for Jerusalem: 1st Gen. worn 8.V., 2nd Gen. from 1.VI. to 30.VI. He adds that it is partial to the flowers of *Eryngium creticum*. The 2nd Gen. as a matter of fact occurs much later in favourable localities, *e.g.* on the coast, where the climate is not too dry, it may be taken in IX. in good condition, and even in XI., *e.g.* a Tulkeram specimen in the Hemming Coll. My experience of *H. thersamon* in Asia Minor, Syria and the S. Balkans gives me the impression that these autumn specimens are not a 3rd Gen. but the second part of the 2nd, which is broken by the summer pause from mid-July, but reappears early in August.

H. thersamon occurs in Transjordania, where Mr. Philby took it at Petra 25.III., Bir Ayub Road 21.IV., and 2nd Gen. specimens at Zarqa 24.VII., Fuheis 13.VIII. and Amman 31.VIII.

Variation. Although a certain number of Southern 1st Gen. *H. thersamon* are "tailed," this character is not so general as to justify the employment of Klug's name *omphale* to describe the whole Syro-Palestinian race. Most *omphale* from Syria and Palestine, if usually rather smaller than those from Bithynia, do not differ from them in other respects. On the other hand,

there are some differences in the 1st Gen. of Syria and Palestine from those taken on the Bosphorus and further north, which, after the examination of more material, may justify the separation of the Syro-Palestinian 1st Gen. from *thersamon thersamon*. Not only are some of the 1st Gen. "tailed," but they appear to me to have less dark scaling suffused on the basal areas of fore- and hind-wings on the upperside. Among them occurs a splendid form with brilliant upperside and the greater part of the underside of the fore-wing of a rich orange-red between "orange chrome" and "orange rufous" (Ridgway, Plate II).

In normal examples the underside of the fore-wings is from "light buff" to "warm buff" (Ridgway, Plate XV), at least as far as the discoidal spot, and generally farther. This is a very large form, the fore-wing in some ♀ specimens being 18·5 mm. in length. I think that since it may turn out to be a local seasonal race it deserves a name, and therefore name it "*forma militaris*" on account of its exuberant red colour and of the fact that I took it first near G.H.Q. in Palestine at Bir Yakub (Bir Salem). Types in my collection, taken at Bir Yakub March 18—April 4, 1918. In Mr. Buxton's collection are examples from Sebaste 9.IV. and Jerusalem 26.IV. which approach *militaris*, as do a few of Mr. Philby's examples from Petra and Bir Ayub and specimens in the Hemming Coll. from Tulkeram, and in the Hope Museum from Gaza. I may add that *omphale* in the S. Balkans and Asia Minor, as well as in Syria and Palestine, differs from the vernal generation in the ground-colour of the underside of the hind-wings. In the vernal brood it is usually "drab" (Ridgway, "Colour Standards," Pl. XLVI); in the summer brood occasionally "light drab," more often "drab grey," sometimes "smoke grey" (Ridgway, *ibidem*).

37. **Heodes phlaeas** L. Seas. Forms **eleus** F. and **initia** Tutt, **initia-caudata** Tutt, **nigrior-eleus** Vrty., **aestivus** Z., **fuscata-caudata** Tutt.

Linn., F. Suec. p. 285; Fabricius, Ent. Syst. Suppl., p. 430, "Germany"; *nigrior-eleus* Vrty., Ent. Rec., xxxii, pp. 5, 6, "Florence"; *initia*, *initia-caudata*, *fuscata-caudata* Tutt, Brit. Butt., viii; *aestivus* Zeller, Isis, 1847, "Sicily."

Distribution and Dates. Generally distributed though

not common in some localities, *e.g.* the Steppe south of Gaza, where I only took two specimens in July 1917. Widely distributed in Transjordania as far south as Petra. Emerges in III. if not earlier in hot localities and continues in a series of generations till late Autumn, occurring as late as 26.XI. at Ain Sara (Philby in B.M.).

Variation. A very much larger number of specimens of the 2nd and later Gens. would be required from many localities before it would be possible to state where and when particular seasonal forms predominate. The 1st Gen. in my experience is almost always *phlaeas*. The only very early *initia* which I have seen comes from Jericho, 24.III. The ab. *caeruleo-punctata* occurs, as elsewhere in the Near East, more often in the 1st (Constant) Gen. than in *eleus*, *i.e.* the Southern race or subspecies in the widest sense. The "critical" spot (cf. Mr. E. B. Ford's paper, Trans. Ent. Soc., 1923, p. 704) may look concavely towards the margin or convexly. The extent of the suffusion in the summer forms varies.

The following are the results of an examination of series from Palestine and Transjordania in the B.M., my Coll. and Dr. Buxton's Coll.: C.P. stands for *caeruleo-punctata*. If the critical spot is outwardly concave I describe it as "conc.", if outwardly convex as "conv.", otherwise as neutral (neutr.). The forms are named in accordance with the grading given by Dr. Verity in his most interesting paper in Ent. Rec., xxxii.

Locality.	Date.	Form.	C.P.	Critical spot.
A. Jordan Valley.				
1st Gen.				
Jericho 6 ♂, 1 ♀	17–21.III.	*phlaeas*	4 C.P.	2 conv., 1 conc., 4 neutr.
,, 1 ♂	24.III.	*initia*		neutr.
Later Gens.				
Tiberias 1 ♂	7.IV.	*initia*	C.P.	conc.
Wa. Kelt 1 ♂	9.IV.	*initia-caudata*		neutr.
L. Huleh 1 ♂	m.V.	*fuscata-caudata*	C.P.	neutr.
Wa. Kelt 1 ♀	16.V.	*aestivus*		conv.
L. Huleh 1 ♀	24.V.	*eleus*		neutr.
Ain Sara 1 ♂	26.XI.	*phlaeas*		neutr.

6 out of 14 specimens are *caeruleo-punctata*. In 3 the critical spot is convex and in 2 concave.

Locality.	Date.	Form.	C.P.	Critical spot.
B. Coastal Plain.				
1st Gen.				
B. Yakub 1 ♂	10.III.	*phlaeas*	C.P.	neutr.
Later Gens.				
Jaffa 1 ♀	15.V.	*eleus*		conc.
Haifa 2 ♂	22.VI.	*aestivus*	1 C.P.	1 conc., 1 conv.
D. el Belah 1 ♂	VII.	*aestivus*		conv.
,, 1 ♂	e.VII.	*fuscata-caudata*		neutr.
C. Plateaux (Palestine).				
1st Gen.				
Kolonia 1 ♀	25.III.	*phlaeas*	C.P.	conc.
Galilee 2 ♂, 1 ♀	IV.	*phlaeas, initia*	C.P.	1 conc., 1 neutr.
,, 1 ♀	V.	*phlaeas*	C.P.	conc.
Later Gens.				
Nazareth 1 ♂	11.V.	*phlaeas* (large)	C.P.	conc.
,, 1 ♀	23.V.	*eleus*		conv.
Jerusalem 1 ♂	7.VII.	*fuscata-caudata*		conv.
D. Transjordanian Plateau.				
1st Gen.				
Petra 3 ♀	19–29.III.	*phlaeas*	C.P.	2 conc., 1 neutr.
Salt 1 ♂	18.IV.	*eleus*	C.P.	conc.
Later Gens.				
Ain Salaha 3 ♂	18.V.	*nigrior-eleus*		1 conv., 1 conc., 1 neutr.
Jerash 1 ♀	19.V.	*eleus*		conv.
Zarqa 1 ♂, 1 ♀	25–27.VII.	1 *nigrior-eleus*, 1 *eleus*	1 C.P.	1 conc., 1 neutr.
Amman 1 ♂, 1 ♀	31.VIII.	1 *nigrior-eleus*, 1 *eleus*		1 conc. 1 neutr.

2 out of 6 specimens are *caeruleo-punctata*. In 2 the critical spot is concave and in 2 convex.

5 out of 7 are *caeruleo-punctata*. In 4 the critical spot is concave and in 2 convex.

5 out of 12 specimens are *caeruleo-punctata*. The critical spot in concave in 5 and convex in 2.

Mr. Ford's results for Syria-Palestine are: Constant Brood, 6 specimens examined. 5 *caeruleo-punctata* (83%). Critical spot "turned out," *i.e.* concave, in 5 specs. (83%).

Racial Broods, 25 specimens examined. *Caerulco-punctata* 40%. Critical spot concave 16%, convex 64%.

My results are: Constant Brood, 17 specimens examined. 13 *caerulco-punctata* (76%). Critical spot concave 50%, convex 11% (approx.).

Racial (Later) Broods. 22 specimens examined. 5 *caerulco-punctata* (23%). Critical spot, concave 45%, convex 31% (approx.).

In the ♀♀ of the later generations the copper colour is very lustreless and yellowish. The tails are often accentuated in both sexes in these generations.

From the above it seems fairly clear that in the 1st Gen. in Palestine *caerulco-punctata* is the dominant form.

(Note. In the Hemming Coll. are some extremely dark specimens taken at Ludd in VII. VIII.)

38. **Tomares (Thestor) nogelii** H.-S. subsp. **nesimachus** Obthr.

Oberthür, Études d'Entomologie, Part 18, p. 14, Pl. II. fig. 30. "Akbes."

A single ♀ of this very handsome subspecies of *T. nogelii*, unfortunately in bad order, is in the Hope Museum, Oxford. It forms part of a collection made by Mr. V. G. Bell in the Gaza District in the cultivation at the edge of the Sinai Desert (*i.e.* presumably of the Southern Steppe) in III. V. 1918. The specimen agrees in all respects with M. Charles Oberthür's figure and description. This handsome insect should be looked for in Steppe areas in Palestine, notably in Southern Judaea. Its discovery so far south is most interesting. The subsp. *aurantiaca* Stgr. or a form close to it occurs at Dlibta, near Ghazir in the W. Lebanon, near the sea at an altitude of nearly 3,000 ft.

PAPILIONIDAE.

40. **Papilio machaon** L. subsp. ? **sphyrus** Hb. Seasonal Form (Gen. aest.) **aestivus** Z.

Hübner, Ex. Schmett., pp. 775, 776. "No locality." Zeller, Isis, 1847. "Syracuse, in Sicily."

Distribution and Dates. Not common in my experience, but widely distributed in three generations, occurring from Umm el Kilab 1.VIII.1917 (P.P.G.) and the desert south of Beersheba (not uncommon IX.1917) to Galilee and northwards, Haifa b.III.1921 (P.P.G.) and in the Jordan Valley, nr. Jericho 17–21.III.1921, a few seen. Frequent in some

years nr. Jerusalem, at Ain Sinia, etc. Transjordania, *e.g.* Petra 25.III.–28.III. (Philby).

To judge from Syrian observations *P. machaon* emerges in III. on the low ground, the 2nd and 3rd Gens. following in late V. VI. and VIII. X. It occurs less frequently in Lebanon than *I. podalirius*. Reported by non-entomological travellers from Sinai Mts. Frequent in Cyprus. In Egypt only on the extreme western border at Sollum, which is geographically in Cyrenaica.

Variation. I have not enough material to say whether *P. machaon* of the 1st Gen. in Palestine is the broad-banded form *sphyrus* Hb. In the later generations in Palestine and Syria one finds a few specimens approaching *centralis* (Stgr.), which is the prevailing form in Iraq, a larger number of small specimens with very acuminate fore-wings, and perhaps a majority of fair sized or large specimens on the whole resembling those from more northern parts of the Levant.

41. **Papilio alexanor** Esp. subsp. **orientalis** Rom. and (or) **Judaeus** Stgr.

Romanoff, Mem. Rom., i, p. 41, Pl. V, fig. 1, 1884, described *orientalis* from a single ♀ from Ordubad. Subspecies *judaeus* Staudinger, Iris, vi, p. 369 = subspecies *maccabaeus* described in Iris, iv, p. 224, 1889. "Jerusalem," the latter name being withdrawn by Staudinger because it had already been applied to a subsp. of *Papilio macareus*.

Distribution and Dates. A local species occurring on the Plateau at several localities near Jerusalem, *e.g.* Joseph's cave; reported as seen near the summit of Nebi Samwil in b.m.V.1918. A Jerusalem specimen dated 12.V.1918 is in the Mus. Min. Agr., Cairo. *P. alexanor* will probably be found in Galilee at heights of over 2,000 ft. Occurs very locally in Lebanon, up to 4,500 ft. at Ain Zahalta. There it appears from m.V. to b.VI. according to altitude. May is certainly the month to look for it in Palestine.

Variation. *P. alexanor* being local and not at any time an easy insect to catch, it is not surprising that no large amount of material from Asia Minor and Syria is available, and it is therefore still uncertain whether *orientalis* Rom. is merely an aberrant form of *judaeus* or not. Two ♀♀, both taken by me at Ain Zahalta, Lebanon, are nearer to *orientalis* than they are to *judaeus* as figured by Verity,

Rhop. Pal., but others which I have seen from Asia Minor are *judaeus*.

(The Near Eastern *alexanor* only differ slightly from nymotypical *alexanor* in having a little more blue scaling on the bands across the upperside and a more deeply indented distal margin to the hind-wings.)

42. **Zerynthia cerisyi** Godart, subsp. **speciosa** Stich.

Stichel, Ent. Zeit., xxi. pp. 82, 83, 1907, also Verity, Rhop. Pal., Pl. LVII. figs. 9, 10, 1910. "Jerusalem."

Distribution. Generally distributed and locally frequent and sometimes common on the Plateaux at least as far south as Hebron and on Mt. Carmel, but only locally in the plains and seemingly absent from the Jordan Valley. Occurs in Transjordania (Philby, Brit. Mus. Coll.).

Dates. One generation appearing according to altitude and season early or late in March, and at its higher localities (*e.g.* The Mount of Olives) early in April in backward years. Occurs throughout April, and may be taken early in May at the highest points of the Plateaux.

Variation. The Syro-Palestinian race *speciosa* appears to me to be somewhat variable and to form a transition between Godart's *cerisyi* (type locality = Smyrna) and Oberthür's *deyrollei* described from the "Alps of Pontus." Generally speaking it is nearer the former than the latter, and this seems particularly the case with the form which predominates about Jerusalem. The "tail" on the hind-wing on *M*3 is usually longer than those on *CU*1 and *CU*2, but I have seen Palestinian and more often Syrian specimens with all three "tails" of equal length as in *deyrollei*. Sexual dichroism is less marked than in many *deyrollei*, more so than in most *cerisyi cerisyi*. Aberrations occur among the ♀♀, cf. *ab. alba*, of which Mr. Buxton has a specimen taken near Jerusalem.

If, as Rebel thinks, *speciosa* Stich. is not justified as a subspecific name, *transitus ad deyrollei* or *transitus ad cerisyi* would meet the case of the Syrian forms of *cerisyi*, south of Aintab. May I add here that the yellow to orange subapical blotch of the underside of the fore-wings is of no value as a determinant between *deyrollei* and *cerisyi*. It is certainly more frequent and usually better marked in *deyrollei*, but I have specimens of both *cerisyi* and *speciosa* in which it is quite as noticeable.

The *Z. cerisyi* of Transjordania (Jubaiha 23.IV., Salt 18.IV., Nuwaiqis nr. Amman 28.III. and 4.IV., all 4 specimens taken by Mr. Philby in 1922-23) do not differ from the Palestine form.

Food-plant. Aristolochia parviflora at Jerusalem (Swinton).

43. **Archon apollinus** Hbst. subsp. **bellargus** Stgr.

Staudinger, Iris, iv, p. 22, 1891. "Kessab near Antioch."

Distribution and Dates. Widespread on the Plateau as far south as Hebron if not further, and locally on the plain, *e.g.* nr. Bir Yakub. b.III.1918 (P.P.G.), but not recorded from the Jordan Valley nor yet observed in Transjordania. Occurs in the Southern Steppe, *e.g.* Der el Belah, 27.II. (Hemming Coll.). Throughout Syria to over 6,000 ft., and Asia Minor except the highest regions, and lately taken by Dr. Buresch in Thrace (subsp. *thracica*). Barraud records an emergence in November. It appears even on the Plateau as early as December and in late seasons may still be found in good condition near Jerusalem in early April. (There is a specimen from Roshpina, 1,500-2,000 ft., in the Hemming Coll. dated 18.XII.)

Variation. The typical *apollinus* was described from "Ourlac," *i.e.* Vurla or Clazomenae near Smyrna. The race *bellargus* is more heavily marked with dark submarginal scaling on the hind-wings. A good many Palestine specimens are *bellargus*, others intermediate between it and typical *apollinus*. Palestine ♀♀ sometimes make some approach to the form *aurantiaca*, described by Culot from Beirut and the normal ♀ form there. The race from Roshpina near Safed in Galilee is rather smaller than that from the Jerusalem district. Gaza specimens in the Hope Museum, Oxford, are unusually large.

Food-plant. Aristolochia parviflora at Jerusalem (Swinton).

PIERIDAE.

44. **Aporia crataegi** L. ? subsp. **meridionalis** Vrty.
nova subsp. augustior, mihi.

(Plate V, fig. 10.)

Verity, Rhop. Pal., p. 324, Pl. LXVI, fig. 3, 1911. "Syria." Subspecies *augustior*, mihi, in sequente descripta. "Salt, Transjordania."

Distribution, Dates and Variation. I regret that the specimens from the Judaean Plateau before me are neither numerous enough nor in sufficiently good condition, a *sine qua non* in this species, to enable me to say whether they are *meridionalis* or another subspecies of *A. crataegi*. The species occurs locally nr. Jerusalem, *e.g.* Mt. of Olives (Swinton) in IV., Nebi Samwil Mt. 22.IV.23 (Buxton), also nr. Ain Sinia, N. of Ramallah, e.IV.1918 (Coll. Min. Agr. Cairo). It is very local on the western slope of the Lebanon, but abounds on the eastern slope and is locally common in the valleys of the Anti-Lebanon, occurring at Damascus. The Lebanon and Anti-Lebanon race is sometimes *meridionalis*, sometimes apparently a transitional form between it and *augusta* (Turati, Nat. Sic., xviii, pp. 26, 27, Pl. 1, figs. 2, 3, 4, 6, 7. "Ficuzza, Sicily"), but there and near Constantinople, though in my experience rarely, specimens resembling *augusta*, or even showing its characters in an exaggerated form, occur. On the whole I am inclined to set down the Palestine race as *meridionalis*. In Transjordania occurs a fine local race which I describe below as *augustior*, because it exhibits some of the characters of Turati's *augusta* to a greater degree than *augusta* itself or than even the aberrant individuals previously mentioned.

Description of Aporia crataegi subsp. augustior. Described from 14 specimens, all males, taken at Salt (8), Bir Ayub Road (5), Jubaiha (1), in Transjordania, from 18.IV. to 25.IV.1923, by Mr. H. St. J. Philby and now in the B.M.

Length of fore-wing, maximum 33·9 mm., minimum 31 mm., average 32·4 mm. Differs from *augusta* by the great intensification of the black marginal scaling at the extremities of the nervules. The triangle in area 7 on the upperside of the fore-wing formed by *Sc*3+4 and *Sc*5 is entirely black in 13 of the specimens described, and contains only a few white scales in the fourteenth. The white ground-colour never reaches the apical margin in area 9, and seldom extends as far as the distal margin in 7, the apices of the black triangles at the extremities of nervules *Sc*3+4 to *R*2 invading the white to a distance, in extreme specimens, of 5 mm. from the margin. Area (interspace) 9 is only entirely free from black scaling for half its length in some of these specimens, and the black triangular marking is well-marked even at the extremity of *M*2. The distal extremity of *SM*2 is rather heavily scaled with black for from 3 to 4 mm. in half the specimens under review. The

linear spot closing the distal end of the cell is well marked, but does not appear quite as broad as in *augusta*. On the hind-wings the black scaling at the marginal extremity of *Sc*2 is generally well marked. On the underside of all wings the nervules are heavily suffused along their length with black, and the ground-colour is of a dead white without any yellow tinge. Areas (interspaces) 1, 2, 3, usually show some black scaling mixed with the white. In a few specimens this extends into interspace 7.

Unfortunately no females are available for description.

Individual Variation. Although *alepica* Cosmovici, would seem from the description "entirely without scales" to be the result of wear and tear, I have a specimen in good order from near Baalbek which is extremely hyaline.

45. **P. brassicae** L. subsp. **verna** Z. (**catoleuca** Röber falls before **aestiva** Z., which in turn falls before **verna** Z.).

Zeller, Isis, p. 222, 1847. "Messina, Sicily." Röber Ent. Nachr., p. 81, 1896. "Taurus and Syria."

Distribution. *P. brassicae* occurs in Palestine generally in the neighbourhood of human settlement. I have only seen it in any numbers twice, viz. near Jericho, 17–21.III.21, and near and in Jerusalem in IV.22. At Haifa, though it occurred both on the lower slopes and on the summit of Mt. Carmel early in March in 1921, it was by no means common. The larva occasionally troubles cabbage-growers at Jaffa and Jerusalem. Bethlehem, Gaza (singly), Wilhelma nr. Jaffa and Khan Yunus (one specimen seen in the late autumn of 1917), are other places where I have noted its appearance. The last-named is of interest, being an oasis in the dry southern steppe, where one would not expect to find *brassicae*, which I may add does not occur at all in Egypt. In the Hemming Coll. is a specimen taken at Beersheba on 17.III. Transjordania, Amman (Philby). Widespread, but not usually very frequent in Syria near human settlement, seldom occurring in my experience at any distance from towns, and villages. In the Lebanon up to 4,500 ft. Also occurs in Cyprus.

Dates. In the warmer parts of Palestine in February and March if not earlier. At Jerusalem it began to appear in some numbers in 1922 in the last days of March. The 2nd Gen. (possibly the 3rd in warm localities) with the

characters of *catoleuca* emerges in April and May. After mid-June it seems to become rather rare in Syria and doubtless in Palestine, though occasional late summer and autumn specimens suggest a third generation considerably prolonged by the summer pause.

Variation. The evidence of specimens in the B.M., or taken by myself at Brindisi and Marseilles in summer, convinces me that Verity is right in affirming that *aestiva*, *i.e.* Röber's *catoleuca* (Ent. Rec., xxxvi, Suppl., p. 21) is not confined to the Orient, but is the general summer form of *brassicae* in the Mediterranean basin at lower elevations. It occurs in Cyprus, Greece (Athens), at Constantinople, Smyrna and Rhodes in July and August, giving way to *brassicae* proper in the autumn and early winter. The spring specimens in the Near East are characterised by the frequency of the form *vasquezi* Obthr. or transitions thereto, and in the ♂ of the form *nigronotata* Jach., which I have taken at Jericho and which is frequent at Constantinople. I have also seen specimens from Haifa. The abdomen is fairly well clothed with hairs as compared with the summer generation, cf. Zeller, Isis, 1847, p. 222. The Palestine (Syrian) *brassicae* are usually of fair size, but the summer (2nd and 3rd) generation is usually larger than the first. They differ in no particular from those to be found elsewhere in the Near East. Some of my summer specimens from Haifa and Beirut and a specimen taken at Smyrna 18.X. have the abdomen and thorax heavily scaled with white. Others from these localities and from Constantinople show some white scaling on the abdomen. Some of the specimens from Inner Asia Minor, Florence, Tripoli in Africa and Greece in the B.M. show this character often to a considerable extent, cf. *P. rapae* subspecies *leucosoma* Schaw.

Food-plant. Buxton has bred the species from *Capparis*, which must be added to its list of food-plants which in Palestine includes both wild and cultivated species of *Brassica*.

46. **Pieris rapae** L. subsp. **leucosoma** Schaw.

(Plate V, figs. 8, 9.)

Schawerda, Verh. Z.B.G. Wien, lv, p. 516 (1905). "Beirut."

Distribution. Generally distributed and sometimes locally frequent though less abundant in my experience

than in Turkey, Greece and Central Europe. Occurs more commonly than elsewhere about Jericho and Tabgha, Jordan Valley, in spring, but in some parts of the country it appears to be confined to the immediate neighbourhood of the towns, *e.g.* at Haifa, where in early March 1921 it occurred in gardens near the town and on the lower slopes of Mt. Carmel, but was not seen on the higher ground (only 1,200 ft.). At Bir Salem near Ramleh, also called Bir Yakub, I did not see a single specimen in the fields and orchards, and it was not unexpectedly absent from the steppe about Der el Belah and Umm el Kilab in Aug.–Nov. 1917. It occurs on the Transjordanian Plateau (Philby in B.M.) near Salt, Amman, etc., but how far it extends to the south and east I have no means of knowing. The steppe is probably its boundary there.

Generally in Syria up to at least 5,500 ft. on the Lebanon and in Egypt in cultivation from Alexandria to Aswan, though most frequent in the Delta, and occasionally in the Maryut Steppe (b.III.1916 at Amria P.P.G.) and still more rarely in the eastern Desert (Wadi Rished, nr. Heluan, in my Coll.).

Dates. This species may be found in most months of the year, though its highest frequency is in the spring months. It occurs in February in the Jordan Valley at Jericho, and is out before the end of the month in warm corners by the sea and sometimes in sheltered spots on the higher ground. On the Plateau near Jerusalem it was out before the end of March 1922, but in small numbers. It appears to be fairly frequent there in April and May, when the 2nd Gen. begins to emerge. I have seen specimens from Haifa in June (P.A.B. Coll.), Beisan and Jericho in the same month, and Amman (Trans. Plateau) in late August (P.A.B.). It seems, however, to be decidedly rare, as is the case in Egypt during the hottest months. After the rains specimens appear here and there in early winter, and it may be taken in the Jordan Valley in December and January. It occurs at Salonika, a vastly colder place in winter, in early December (seen Dec. 10, 1918, P.P.G.), and in Lower Egypt, which is no warmer than the Jordan Valley in winter, may be taken, often frequently from November to March.

Variation. *P. rapae leucosoma* was described from three males from Beirut. The description (in English) runs "body white, hind-wings beneath yellowish, glossy, without black scaling." This description is a good summary

of the characteristics of the Egyptian, Syrian and Cypriot summer race. Schawerda adds, *loc. cit.*, that there is a lemon-yellow streak at the base of the fore-wing below the costal margin, and that the black spots on the fore-wings are small. The female, which he had not seen, has similar characteristics. The two submarginal spots are usually small, the apical spot varies in extent and in the amount of black scaling, and as in the male the insect looks thinly scaled.

Frühstorfer (Ent. Zeit. Stutt., xxiii, p. 42) describes what he alleges to be the 1st Gen. of *leucosoma* from Smyrna under the name of "*vaga*." The description is most inadequate and unconvincing. Without apparently satisfying himself that either the 2nd or 3rd Gen. of *rapae* which occurs at Smyrna is *leucosoma*, he has described the vernal generation of *leucosoma* from a series of spring *rapae* from Smyrna. It is certain that examples close to *leucosoma* or presenting that form occur among others at Smyrna in the hot season, as they do at Constantinople, the Dardanelles, Panderma, etc., but there is no evidence that *leucosoma* is predominant at Smyrna in the hot months any more than it is at Constantinople, Brusa and Panderma, where the prevailing summer forms are more like the Italian, and where the frequency of specimens having one of the characters or even two of *leucosoma* varies according to season and locality. The description of *vaga* is most unsatisfactory. All that Frühstorfer has to say is that it looks like *leucotera* but is somewhat smaller, especially the ♀, and has somewhat more dark scaling on the apex of the fore-wings. The subspecific name is only too well chosen for the object of so vague a description.

This being the case it would seem advisable to refer to the 1st and 2nd Gen. of *P. rapae* in areas where the hot season form is exaggeratedly *leucosoma* respectively as *leucosoma-prima* and trans. ad *leucosoma leucosoma*. Such areas are the Jordan Valley and the Cairo District, except where, as at Beirut, specimens of the 1st Gen., taken 1.III.1921, are obviously and markedly *leucotera*.

The following is a description of the early generation or generations of *leucosoma* from Cairo and the Jordan Valley. The former date from late November to mid-April, the latter from March 8 to April 9. Those from Egypt probably represent two broods. I am of opinion that the Jordan Valley specimens represent a 2nd Gen.

P. *rapae* L. subsp. *leucosoma* Schaw.	Seasonal (winter and spring form).		
	Max.	Min.	Average.
Size fairly large esp. in the male.			
Expanse of f.-w. in 21 ♂ from Jordan Valley . . .	27·5 mm.	24·5 mm.	25·02 mm.
Expanse of f.-w. in 9 ♀ from Jordan Valley . . .	26·0 „	24·2 „	24·5 „
Length of f.-w. in 12 ♂ from Cairo District . . .	27·5 „	23·5 „	25·4 „
Length of f.-w. in 11 ♀ from Cairo District . . .	25·8 „	23·5 „	24·8 „

One ♂ a dwarf ab. from near Cairo with a fore-wing of 19 mm. is omitted.

Male. Apical blotch usually present and fairly well marked, though forms transitional to *leucotera* occur, the lower border of the blotch being sometimes nearly straight to within 1·5 mm. from the discoidal margin and therefore more or less parallel with the anal margin. The dark scaling of the blotch is usually fairly close, though much less heavy than is the case in subsp. *iranica* from Iraq. Submarginal spot usually present but small.

Female. Apical blotch larger than in male, more diffuse in outline, with less heavy dark scaling, which in some specimens is as sparse and open as in British *metra* Steph. On the other hand, the two submarginal spots are usually large and tend to be markedly kidney-shaped in outline, and the upper spot is nearly or quite divided into two oval spots in 2 ♀♀ from the Jordan Valley and 4 ♀♀ from Cairo. The amount of black scaling on the bases of the wings (upperside) and its thinner, outward extension along the costa, etc., varies. It is perhaps more slightly marked in the Egyptian specimens in the B.M. The Jordan Valley specimens taken later than many of those from Cairo show a form that is on the whole more transitional.

In both sexes the underside of the hind-wing is less heavily scaled than in spring *rapae* from Italy (Brit. Mus. Coll.) and Constantinople (my Coll.), also than in a ♂ specimen taken in the Maryut Steppe in early February 1916. The ground-colour of the underside of the hind-wings varies from ochreous yellow, which is frequent in the Egyptian specimens, to a very pale lemon-yellow

which is more prevalent among the Jordan Valley specimens. A fair proportion of ♀♀ and most ♂♂ show a lemon-yellow suffusion on the underside of the base of the fore-wings, which is one of the most obvious characters of *leucosoma*.

Some of the specimens from both areas taken towards the end of the periods given above show an approach to *leucosoma* in having some white scaling on the abdomen. Co-types 1 ♂ 1 ♀ from Cairo Dist., 1 ♂ 1 ♀ from Jericho in B.M.

Specimens from Tabagha, on the Sea of Galilee, taken on April 6, show a still more distinct approach to *leucosoma*.

At Jericho by 20.IV.22, to judge from specimens taken by Mr. P. A. Buxton, the *rapae* flying are individually "75% *leucosoma*," and in May and June this is practically the only form. The progress of *P. rapae* towards *leucosoma* is little less rapid elsewhere in Palestine. Thus I may record trans. ad *leucosoma* from Haifa in early May, Nazareth (1,200 ft.), late May, nr. Jerusalem, late May, and *leucosoma* from Haifa e.V., Wadi Kabala on the Plateau 10 miles W. of Jerusalem 7.VI. This form persists even at high levels till the end of the summer, *e.g.* Amman 30.VIII. at 3,500 ft. in Transjordania. I may here remark that the comparative rarity of *P. rapae* on the low ground in Syria and Palestine in late July, August and September, which is still more marked in Egypt, is due to several causes: the operation of the summer pause, dryness of pabulum retarding development of the larva, and the fact that in both countries garden crucifers are largely cleared away by June, and the cutting of the field crops does away with quantities of the cruciferous weeds (*Sinapis*, *Eruca*, etc.) whereon *P. rapae* oviposits. These factors tend to cause a marked diminution in numbers of the species. At Beirut I only saw and took one *P. rapae leucosoma* between Sept. 10 and 16 in 1910.

For the 1st Gen. occurring in certain parts of Palestine and Syria (*e.g.*, Haifa and Beirut), which is identical with *leucotera* in a majority of cases, I am inclined to use that name as a subspecific name. If it be argued that this name is that of a "form" and cannot be used for a vernal generation of the subspecies *leucosoma*, may I reply that it would be burdening nomenclature unduly to give a new name to a generation which could not be distinguished

from *leucotera* and would have to be described as "â *leucoterâ* patriâ solum distinguenda"?

Verity (Rhop. Pal., p. 155) gives a strongly marked apical blotch as characteristic of *leucosoma*. This is by no means always the case, and in few examples is the blotch as large and dark as in the long series of Iraq *iranica* Le Cerf, in the B.M. The specimens of *iranica* in this series taken by Col. Peile from m.IV. to X., and according to Verity's figure (Rhop. Pal., Pl. XXXIII, fig. 44) subsp. *mauritanica* in its summer form, have the abdomen heavily powdered with white. This character therefore seems to be seasonal rather than geographical. It is frequent among Constantinople summer specimens (July, August), though I have only taken a few individuals in that part of Turkey which are really identical with *leucosoma* in all particulars, 4 in a total of 110. Forms transitional to *leucosoma* are doubtless frequent in the southernmost parts of Europe in the hottest months, but it does not seem certain that true *leucosoma*, uniting all the characters given by Schawerda, including the lemon-yellow dash at the base of the fore-wings on the underside in the male, occurs as a race anywhere in Europe. This last characteristic is less remarkable in the ♀, since in most normal *rapae* ♀♀ the yellowish scaling of the apical blotch on the underside of the fore-wings extends down the costa towards the base.

To sum up, Palestinian and low-ground Syrian *rapae* (the latter from Beirut) may be named as follows:—

A. Gen. I (II), *leucosoma* f. *prima* or trans. ad *leucosoma*, and in Gen. II, trans. ad *leucosoma*. Gen. III, and later Gens. till late autumn, *leucosoma*. Jordan Valley and hot localities. (Also in Egypt, Cairo Dist.)

B. Gen. I, *leucotera* (Beirut and Haifa) or *leucosoma* f. *prima*. Gen. II, trans. ad *leucosoma*. Gen. III, and later till late autumn, *leucosoma*. Other localities in Palestine and at Beirut.

I have not enough 1st Gen. *rapae* from Transjordania to form a definite opinion as to its racial character there. A specimen from Zarqa 24.III.1923 (Philby) resembles *leucosoma* f. *prima*, another of the same date in the B.M. is nearer *leucosoma*. Another ♀ from Zarqa (25.VII.1923) is *leucosoma*, with very bright canary-yellow underside of the hind-wings. Very close indeed to *leucosoma* are specimens from Ain Sulaiha 18.V.1923, and all summer specimens from the Transjordania Plateau until September are "100 per

cent." *leucosoma*. Even 3 ♀ specimens which were taken 26.XI.1923 by Mr. Philby at Ain Sara have *leucosoma* characters, the lemon-yellow dash below the costa on the underside of the fore-wing being clearly marked. A ♀ from Petra 4.IV.1923 is like the *leucosoma* f. *prima* ♀♀ from Jericho. The general impression given by these specimens is that the Transjordanian *rapae* do not differ racially from those of Palestine.

Since the ♀ of *leucosoma* has not as far as I am aware been described, I append the following description thereof.

P. rapae subspecies *leucosoma* ♀. Resembles the ♂ in having the body scaled with white, especially on the abdomen, a bright lemon-yellow streak below the costa at the base of the underside of the fore-wings, and the underside of the hind-wings entirely or almost entirely free from dark scaling and of a glossy appearance. Variable in size and also in the extent of the dark apical scaling and in the size of the spots on the upperside of the fore-wings. The smallest specimens with palest underside of the hind-wings are those from Cairo taken between June and August. Described from a number of specimens from Beirut, Palestine and Lower Egypt (Cairo) in my Coll. and in the B.M. Co-types: 1 ♀ Beirut, b.VI.1911, P. P. Graves ex Cremona, 1 ♀ Khedeira, Coastal Zone, Palestine, 30.V.1921, P. A. Buxton in B.M.

(Note.—*Pieris napi* L. occurs in Syria at Beirut and Bludan (Anti-Lebanon) in the subsp. *pseudorapae*. It has not been recorded from Palestine. It appears to be very local in Central and S. Greece and to be absent from Cyprus. From my observations in the Constantinople region, I should say that it is frequent enough in the more northern parts of the Near East wherever it finds a combination of shade and moisture, *e.g.* in the Brusa Dist. and in the Belgrade and Alemdagh Forests near Constantinople, but that, while it occurs in dry woods with undergrowth, *e.g.* in the pine-woods on Prinkipo by the Sea of Marmora, it is rare in dry open ground at any distance from the sea. Further south it seems to become a very local species. The Dog River Valley at Beirut is a very moist and warm locality with abundant shade. Bludan is well watered and has abundant cover from 3,500 ft. to 4,500 ft. I have never seen *P. napi* at Ain Zahalta, Aleih, or indeed any other Lebanon locality. It is therefore doubtful whether it occurs in Palestine.)

47. **Belenois mesentina** subsp. **mesentina** Cr.

Cramer, Pap. Exot., iii, p. 140, Pl. CCLXX, A, B. "Coast of Coromandel."

Distribution. Occurs throughout Palestine, but in some parts of the country, *e.g.* the southern steppe, where its food-plant (*Capparis*) does not grow, merely as a migrant, coming in occasional flocks only to disappear again. I noted such a migration, composed principally of males, which flew past my dug-out at short intervals on the cliffs at Der el Belah in late July 1917.

As regards its habits, it seems to be an immigrant species, entering Palestine from the south and south-east from the Ghor and the Sinai and perhaps more distant localities by way of the Jordan Valley and Beersheba. It may take the Jordan Valley as a stage in its migration, breeding there in the late spring. I have seen specimens taken there in April and May, and in the Hemming Coll. is one taken at Beersheba 27.IV. and entering Palestine in the next brood. It appears on the Plateau in July, at Beirut near the end of the month, and then spreads rapidly, producing two or perhaps three generations where conditions are favourable, until the first rains, after which it soon disappears. M. Cremona of Beirut informed me in 1910 that it fed up with great rapidity, the whole period from emergence *ab ovo* to the appearance of the perfect insect being from 25 to 30 days. In Syria it does not appear above the 1,000 ft. contour on Mt. Lebanon except as an occasional straggler.

Occurs in Sinai, Arabia, Upper and Middle Egypt in the oases (frequent in April), but seems to be an immigrant in the desert Wadis nr. Cairo, where it occurs in IV.–V. and quite possibly later. Its extra-Palaearctic distribution in Africa, India, etc., is very wide.

Dates. See under "Distribution."

Variation. There is considerable individual variation in this species in (*a*) size; (*b*) ground-colour of the underside of the hind-wings. Very small examples occur in the late summer, when the food-plant for which *Teracolus fausta* competes with *B. mesentina*, however dry and dusty, is covered with the larvae. Between September 10 and September 16, 1910, I noticed many bushes of *Capparis*, on twigs whereof less than a foot long there were from a dozen to fifteen larvae in all stages and several pupae,

often so pressed one against the other that the luckless butterflies had been crippled on emergence or had perished half emerged. The ground-colour of the underside of the hind-wings varies from cream to straw and pale ochre, and frequently has a pinkish glow in the ♀♀.

48. **Pontia daplidice** L. Seasonal Forms **persica** Bien., and **albidice** Obthr.

Bienert, Lep. Erg. einer Reise nach Pers. i. d. Jahren, 1858 & 1859. Leipzig, 1870. "Persia." Oberthür, Et. Ent., vi. 47. "Algeria."

Distribution. This, though one of the most widely distributed species of the Pierids in Palestine, is curiously infrequent in certain localities in certain seasons. It was never seen, perhaps owing to the summer pause and the barren nature of the country, about Umm el Kilab and Der el Belah from early July to November, and that though it had occurred near Der el Belah in the early summer in some plenty in 1917. Again, it was rare at Bir Salem in the early spring of 1918. I only took a single specimen there between January and April. On the other hand, it swarmed in the Jordan Valley in March and on into May, appears to be frequent all over the Plateau and in Galilee in early summer, and occurs less frequently than *E. belemia* of the 2nd Gen. but in considerable numbers in the Coastal Plain after early April. It occurs at Petra and elsewhere on the high Plateau in Transjordania, and in late May 1905 was seen by me in great numbers in the steppe N. of Katraneh on the Hejaz Railway in the same latitude approximately as the southern extremity of the Dead Sea, but of course at a far higher altitude.

P. daplidice occurs abundantly in Syria proper, reaching an altitude of 6,600 ft. at the Cedars of Lebanon, in Cyprus and the Sinai Peninsula, and locally and not usually frequently in Egypt.

Dates. Jaffa Dist. (XI. P.A.B.) trans. ad *bellidice*, Khan Yunus e.XII.1917 (P.P.G.), nr. Ramleh at Bir Salem m.III.1918, worn. 8 m. E. of Jerusalem, *circa* 2,000 ft., 8.III.1922, ♀, others seen. Jericho abundant 17–21.III.1921 and e.IV.b.V.1922 (P.P.G.). Khedeira, Haifa, Nazareth, etc. II.–V. to 30.VI. (P.A.B.). Ludd VII. and VIII. (Hemming Coll.) Jerusalem Dist., etc.

Transjordania. Petra 22–24.III.1923 (P.A.B.) Jerash 19.V.1923 (*albidice* ♂, trans. ad. *albidice* ♀), Zarqa 25.VII.1923

(*persica* ♀), Fuhais 13.VIII.1923 (*albidice* ♂), Wadi Sir 14.VIII.1923 (*persica* ♀), Ain Sara 26.XI.1923 (*daplidice* ♂♀ with slight approach to *bellidice*). All taken by Philby, in B.M.

Variation. Before describing the forms of *daplidice* which occur in Palestine, it is necessary to give the gist of the descriptions of *persica* and *albidice*. Bienert describes *persica* as "smaller (than German *daplidice*), the hind-wings scaled with yellowish-green on the underside, the venation bright lemon-yellow." He adds that on the underside of the hind-wings the white ground-colour predominates, "Während bei der Stammform grün vorherrscht tritt bei der Varietät das Weiss hervor." It has been suggested that Bienert confused a form of *glauconome* with *daplidice*, but there is no reason to suppose that he made this error. He describes the form (2nd Gen.) *iranica* of *glauconome* in the same paper, and would seem to have found the two species together. They certainly occur together in Egypt and Sinai, not to mention Iraq, and, even if they did not, why should the German naturalist have been guilty of such a confusion?

Oberthür's description of *albidice* from Algeria, where it occurs in its most marked examples in the semi-desert or desert country south of the Atlas, runs "smaller than the spring form; very white above with the underside markings scarcely showing through the wing. These markings are much reduced in size, not strongly marked, obliterated near the anal margin and yellowish-green in colour. The abdomen is much less hairy than in the spring form."

Raphani, described and figured by Esper, Schmett. Abb., I, p. 163, Pl. I, fig. 2, is according to the figure the S. African *hellica* mistakenly recorded from S. Russia. This name therefore, as Oberthür has pointed out, has no application to *daplidice*.

The comparison of a large number of specimens of *daplidice* from the Near East (Asia Minor, S. Balkans, Syria, Palestine, Iraq, with a smaller number from Cyprus and Egypt) in the B.M., Mr. Buxton's collection and my own, suggests the following deductions.

A. The Central European Gen. I, *bellidice* occurs as an early spring form in the colder parts of the Near East, *e.g.* at Constantinople, where vernal specimens taken in April and early May are indistinguishable from German *bellidice*. Similar specimens are taken further south, *e.g.*

Smyrna, April, m. Coll. Athens e.III. m. Coll. In the Mus. Min. Agr. at Cairo is a *bellidice* taken at Dakehla west of Alexandria in February, and some of Mr. Philby's *daplidice* from Petra (3,500 ft.) in March are very near *bellidice*. But the normal early *daplidice* of the winter or early spring emergence from Palestine are rather to be described as transitional between *bellidice* and typical *daplidice*. Examples taken in the desert east of Cairo as late as mid-April show certain of the characteristics of *bellidice*. *Bellidice* shows (1) a mixture of white scales with the black apical scaling on the anteriors and in the ♀ with the black scaling on the hind-wings often to such an extent that the general optical effect is bluish-grey; (2) very heavy and dark green scaling on the underside hind-wings, the white spaces on which are greatly reduced; (3) hairier body and generally (4) smaller size.

B. In the late spring in the northern part of the area under consideration specimens combining some of the characters of *bellidice* with those of *daplidice* occur, cf. Constantinople in May. Further south by late April *daplidice* proper occurs at low or moderate elevations. The race taken by me at Jericho 17–21.III.1921, probably a 2nd Gen. or rather the first instalment of a 2nd Gen., since nearly all specimens were in good order, might best be described as *daplidice* sometimes showing a transition towards *persica*, more rarely vestiges of *bellidice*. Mr. Buxton took a specimen at Nazareth (1,200 ft.) on 11.V. which combined a *bellidice* upperside with the underside of *persica*. In the Hope Museum is a remarkable ♂ with the characters of an exaggerated *albidice* taken at Haifa by Capt. Barraud as early as 2.IV.1920.

C. By late May and June the 2nd (or 3rd Gen.) in Syria, Palestine and Egypt is, except at high elevations, either trans. ad *persica*, or *persica* (*e.g.* a ♀ from Wadi Kabala 10 m. west of Jerusalem 2.VI.) or in the hottest localities *albidice*. Specimens from the Jordan Valley in early May are either *persica* or trans. ad *albidice*, which appears to me to represent not so much a geographical as a seasonal variation, its characteristics being an exaggeration of those of *persica*. In both forms the decrease of villosity and the increase of white scaling on the body, especially the abdomen, are very marked. These last two characters appear in other Pierids, e.g. *P. brassicae* and *P. rapae*, *S. glauconome* and to a certain extent in *E.*

belemia. They also appear in the Near Eastern species of *Leptosia* in the summer generations and in the hot-season forms of the Papilionids, *P. machaon* and *I. podalirius*.

D. Nearly all specimens of *daplidice* taken in July and August which I have seen from Syria and Palestine were either *persica* or *albidice*. I have a very well-marked specimen of the latter which was taken at an altitude of 6,600 ft. at the Cedars of Lebanon, a dry locality. *Albidice* seems the prevailing form at Beirut in this period. Egyptian specimens taken between the end of May and the end of June near Cairo are all *albidice*. Further north, and apparently in Cyprus, the prevailing form is *persica* or a race showing a transition between *daplidice* and *persica* with a large minority of individuals approaching the latter (Constantinople VII.b.m.VIII.). The Iraq specimens taken by Col. Peile, of which there is a long series in the B.M., may be summed up as *daplidice* in spring, predominantly *persica* from early May to about June 16; from June 16 to July 1 ♀♀ are *albidice*, often exaggerations thereof, while ♀♀ are more transitional. July specimens are all *albidice*. In the Hemming Collection are some extraordinary ♂♂, taken near Ludd and Tulkeram in the Coastal Plain in VII.b.VIII, which have only vestiges of the greenish scaling on the underside of the hind-wings. I may note that generally speaking the males show the extremer characters of these dry-season races more rapidly and completely than the females. Thus a ♂ from Nazareth taken by Mr. Buxton on 30.VI.1921 is near *albidice*, but a ♀ taken there on the same date is *daplidice*.

From the above it will be seen that to all appearance the variation of *P. daplidice* in Palestine and the neighbouring countries is purely seasonal. It seems therefore inadvisable to apply the names *albidice* and *persica* to the *P. daplidice* of the Near East as subspecific names.

49. **Euchloë belemia** Esp. subsp. **palaestinensis** Röber.

Röber, in Seitz, Macrolep., Faun. Pal. I, p. 51. "Palestine."

Distribution. This species occurs throughout Palestine and is in most parts of the country the most abundant butterfly during its emergence. It is extremely common in all but the most highly cultivated parts of the Coastal Plain from Haifa (Plain) to Gaza, and occurs as far as Khan Yunus and the Egyptian border, where the steppe gives way to

real desert. It is also very abundant at Jericho and elsewhere in the Jordan Valley, *e.g.* Tabagha, Tiberias, Beisan, etc. On the Plateau it is less abundant but by no means rare, *e.g.* at Kolonia and elsewhere nr. Jerusalem and at Bethlehem, though there *E. ausonia* appears more numerous. It was not common on Mt. Carmel early in March in 1921, but I fancy I visited this spot towards the end of the 1st emergence and before the appearance of the 2nd. It occurs in Transjordania : 1st Gen. Petra 10.III. and later, 2nd Gen. Zarqa 24.IV.1923 (Philby, in B.M.).

In Egypt (not in the Northern Delta) on cultivation, and not very commonly in the Beirut Dist. on the littoral, and at Damascus and doubtless elsewhere in Syria. Its furthest Northern localities are in the Cilician Plain (Missis, etc.). Occurs in Iraq.

Dates. In the Jordan Valley and in the warmer parts of the Coastal Plain odd specimens occur before the new year (Khan Yunus, 28.XII.1917, P.P.G.), though the species is less often seen before January than in Egypt, when it is well out by the end of XI. In the Coastal Plain it is frequent or abundant according to weather conditions from January to mid-April. In the Jordan Valley (Jericho) 1st Gen. specimens are out in December, January and February. The species swarms at Jericho in March and early April in the hot-season form (*palaestinensis*), and is abundant further up the Valley in early April. On the Plateau fresh specimens of the winter form are to be taken about Jerusalem in March. There the hot-season form appears later in April than on the low ground. For Transjordanian specimens see under " Distribution."

Variation. A. *Geographical.* Röber separates the Palestine 2nd Gen., or rather summer form, of *belemia* under the name of *palaestinensis* on account of (*a*) the larger size of the white spots within the dark apical area; (*b*) the marked reduction of the green bands on the underside hind-wings. He evidently regards it as a different form from his *distincta*, which he described at the same time from Philippeville, N. Algeria. This, he says, has a much larger spot than *belemia belemia* at the extremity of the discoidal cell, a yellowish-white ground-colour (?) and more definitely green underside of the hind-wings, besides a greater extension of the dark apical area on the upperside fore-wings.

I cannot quite understand what Röber means by the

"yellowish-white ground-colour" of *distincta* unless he refers to the underside of the hind-wings. Specimens of the later generation of *belemia* are of a more creamy white than the winter and early spring specimens, which are of a cold "china white" on the upperside, but the difference between a "cold" and a "warm" shade of white does not quite justify his use of the adjective "gelblich-weisser."

On the whole, many of the Palestinian (and Egyptian) *belemia* of the summer or late spring form appear to differ from those of Spain (*belemia glauce*) and those of N. Africa (*glauce* and *distincta*) in having less green on the underside of the hind-wings, in having the diminished green bands more extensively suffused and edged with yellow scaling which sometimes suffuses the intervening white spaces, in their larger average size, especially in the specimens from the Coastal Plain and Jordan Valley, and in the larger white spots within the well-developed dark apical marking on the upperside fore-wings.

As regards the 1st Gen. or rather the winter and early spring form, the Palestine specimens which I have examined, as well as the Transjordanians and Egyptians, seem to have as a rule rather larger white spots within the apical area as in the summer form. The Palestine specimens from the low ground and the Egyptians seem to be on an average a little larger than the N. Africans and the Iberian *belemia*. Those from the Plateau and Transjordania are of much the same size. I can see no difference between Palestine and Egyptian specimens except that the latter, taken from XI. to e.I., have on an average rather narrower silvery white bands across the green ground of the underside of the hind-wings. The Egyptian and Syro-Palestine specimens also seem to me to have the anal angle of the hind-wings on an average less acute than is the case with the Iberian *belemia* and, perhaps, the N. Africans. I therefore give the name *palaestinensis* f. *prima* to the cold-weather form of *palaestinensis* Röb.

Description. On an average larger and with less angular hind-wings than *E. belemia belemia* from the Iberian Peninsula and Mauritania, with relatively larger white spots within the dark apical area on the upperside of the fore-wings. Described from a long series from Palestine (33 ♂♂, 22 ♀♀), Egypt (16 ♂♂, 9 ♀♀), Syria (8 ♂♂, 4 ♀♀), Transjordania (8 ♂♂, 4 ♀♀), in the B.M., in my collection,

and that of Dr. P. A. Buxton. Egyptian specimens have very slightly narrower white bands as a rule on the underside of the hind-wings, and those from the Plateaux of Palestine and from Petra in Transjordania are not often larger than those from the Iberian Peninsula and Mauritania. A seasonal form of subsp. *palaestinensis* Röb. linking up with *palaestinensis* through intermediate forms in the Coastal Plain of Palestine (see Ent. Rec., xxxi, p. 63) and probably elsewhere.

B. *Seasonal.* May I refer the reader to my note on this subject in the Ent. Rec., vol. xxxi, p. 63? In this I expressed the belief that the progeny of the 1st Gen. of *belemia* (*sensu lato*) in Palestine is not necessarily always *palaestinensis* (in the note I wrongly used the subsp. name *distincta* for *palaestinensis*, having no works of reference by me when I wrote it), but that, the species being extremely susceptible to climatic conditions, some were *belemia*, i.e. *palaestinensis* f. *prima*, others an intermediate form to which I tentatively gave the name *intermedia*, which I now learn from Count Turati's paper on the Lepidoptera of Cyrenaica (Att. Soc. It. Sci. Nat. Milan, 1921, pp. 211–219) had already been given to an analogous form from Algeria by M. Charles Oberthür, and others, again, were *palaestinensis* (named *glauce* in my note). A specimen in the Hope Museum, Oxford, taken at Nazareth 25.V.1920, is singular in having the upperside of *belemia palaestinensis* f. *prima* and the underside of *intermedia*. May I add that so far as I am aware no descriptions of the hot-season forms of *belemia* draw attention to the great increase of white scaling and decrease of villosity on the body, especially the abdomen; cf. *P. rapae leucosoma*. This is especially marked in specimens from Iraq.

C. *Individual.* Mr. Buxton's Coll. contained a fine example of the ab. *alexandri* named by Turati in the above-mentioned paper. This specimen is now in the B.M. I have among my *palaestinensis* two "albinistic" specimens, one of the 2nd Gen. These have very pale and diffused apical marking, scarcely any trace of black spotting on the underside of the costa, a very yellow costal edge and wide white bands on the underside of the hind-wings.

50. **Euchloë ausonia** Cr. subsp. **melisanda** Frühst., and Seasonal Form (Gen. 1) **triangula** Verity. Subsp. **aegyptiaca** Verity.

Frühstorfer, Ent. Zeitung, xxii, p. 50, 1908. "Jerusalem." Verity, Rhop. Pal., p. 176, Pl. XXXVI, fig. 34, and Pl. L, fig. 10 (*triangula*). "Akbes, Jerusalem"; p. 337, Pl. LXVII, figs. 28, 29 (*aegyptiaca*). "Wadi Hof, nr. Heluan, Cairo, Egypt." Types in B.M.

Distribution and Dates. On the whole *E. ausonia*, though widespread in Palestine and frequent and indeed sometimes abundant in many localities, is more local in the country and more characteristic of its rockier Plateaux than its congener *E. belemia palaestinensis*. On the plain it occurs nr. Bir Salem (Bir Yakub) nr. Ramleh, but much less frequently there than *E. belemia* Tulkeram, abundant nr. Haifa (v. Kalchbg.), at Ludd and elsewhere. On the Plateaux it is frequent near Jerusalem, *e.g.* at Kolonia and nr. Bethlehem, also nr. Ain Sinia and Nablus (Mus. Min. Agr. and Hemming Coll.) in Galilee (Pratt).

Variation. In the above localities *ausonia* occurs in the forms *triangula* (early spring) and *melisanda* (late spring and early summer), and may properly be described as subspecies *melisanda*, the Palestine specimens generally being distinguishable in the 2nd Gen. from those of Greece, the Constantinople Dist., and other parts of Asia Minor and from the race which occurs in Cyprus and apparently also in Cilicia. Barraud (Ent. liii, p. 226) describes the Jordan Valley specimens taken at Jericho in early April as *aegyptiaca*, but this does not agree with my own experience. The 1st Gen. from Jericho, to judge from my meagre material, is close to, or identical with that of parts of the Coastal Plain and of the Plateau. The specimens taken in the foothills in late March, about 200 ft. above Jericho, are well marked *melisanda*. Specimens from Jisr Banat Yakub, the bridge across Jordan between Lake Tiberias and Lake Huleh, in early April, are like the Plateau form, but I do not know whether Dr. Buxton took them in the low valley or on the mountains above it.

In Transjordania at Petra occurs a race which contains so many specimens of subspecies *aegyptiaca* as to deserve that subspecific name. Out of 11 ♂♂ and 4 ♀♀ which were taken there by Mr. Philby between March 11–31 in

1922–23, 7 ♂♂ and 3 ♀♀ are *aegyptiaca* indistinguishable from the form which occurs in the Arabian Desert east of Cairo.

To revert to the Palestine race, Verity points out (Rhop. Pal., p. 175) that Gen. I. *triangula* is not universal in Palestine, a form which resembles the Sicilian race occurring at Bethel. Still, the examples from the Plateau which I have seen or taken include a fair proportion of *triangula* in which the black spot below the costa on the upperside of the fore-wings is triangulate and the wings rather slender in accordance with Dr. Verity's description. The name *triangula* may therefore be applied to the 1st Gen. of Palestine *ausonia*, but the difference between 1st Gen. specimens from Palestine and those from Asia Minor, Greece and the Balkans, appears to me to be much less marked than that between Gen. II *melisanda* from Palestine and Gen. II *maxima* from Athens, Constantinople, etc.

The Cyprus race may be *taurica* Röb., but I am not too certain that it does not differ constantly from *taurica* from Cilicia, etc. The race *aegyptiaca*, which runs into the Cyrenaic race described by Verity as *libyca* in the west, should be looked for in the extreme south of Palestine proper and in the lower parts of the valleys leading down to the Dead Sea. It appears to be a desert race.

51. **Euchloë charlonia** Donz. subsp. **charlonia.** Seasonal Form (1st, cold-season, Gen.) **levaillantii** Luc.

Donzel, Ann. Soc. Ent. France, 1842, p. 197, Pl. VIII, fig. 1. Seasonal form *levaillantii* Lucas, Bull. Soc. Fr., 1847, p. 50.

Distribution and Dates. In Palestine this pretty species appears to be confined to the lower Jordan Valley. It occurs at times in some numbers on each side of the Jordan on the downlands immediately above the thickets and patches of desert or rather of salt land near the river. It is commonest nr. Jericho between the town and the foothills. I found it quite abundant there March 17–21, 1921. It was then very fresh and few ♀♀ were out. It had the habit of settling on the ground and when walked up of flying round in a track resembling a figure of 8. In the following year it was already out in the second week of February, and very few specimens were seen in March. Barraud on the other hand took it in early April, 1920 (Ent., liii, p. 226). Specimens in the Mus. Min. Agr.,

Cairo, taken by the late Mr. Storey nr. Jericho in November, are *levaillantii*, a smaller form with more acuminate fore-wings and with darker apical marking. Their capture suggests that in the Jordan Valley *charlonia* has two generations: the first (winter form) in November to December, the second, *charlonia*, from February to April. *E. charlonia* also occurs in Transjordania and Nabataea, *teste* 2 examples in Mr. Philby's Coll., one taken at Nuwaiqis nr. Amman at at least 3.000 ft. 28.III.1922, and one taken 8.III.1923 nr. Anaiza Station on the Hejaz Railway about 20 m. north of Maan. Both are now in the B.M.

Variation. The Palestine and Transjordanian *charlonia* are generally similar to the N. African race and not to subspecies *penia* from Lebanon, where it is local, and parts of Asia Minor. Another race near the N. African occurs in Western Asia Minor (specimen from Kedos, in the Smyrna Hinterland in B.M.). *E. charlonia* also occurs in E. Thrace and locally in Macedonia (*e.g.* Ekshisu nr. Florina, *teste* Rebel). Only one Egyptian specimen taken early in February by Andres in the Maryut steppe is recorded. The fact that the Transjordan race resembles that from N. Africa and the Jordan Valley rather than the Lebanon race is most interesting. Given the great difference of altitude between Jericho and Amman (from — 800 to + 3000 ft.) one would have expected Transjordanian specimens to bear a greater resemblance to those from Asia Minor and Syria.

52. **Anthocharis cardamines** L. subsp. **phoenissa** Kalch.

von Kalchberg, Jahrsber Wien. Ent. Ver. vol. v, 1894, p. 27, and *ibidem*, vii, 1896, Pl. I, figs. 3, 4. "Haifa."

Distribution and Dates. This beautiful little subspecies of *cardamines* occurs in many parts of the Plateau, and is abundant on Mt. Carmel. It swarmed in some of the valleys there in the first ten days of March 1921. It also occurs locally on the Coastal Plain, *e.g.* Bir Yakub b.III.1918, at Tulkeram III.b.IV. and in the plain of Jenin 22.III. (Hemming Coll.). I have seen it in the valleys below Bethany, east of Jerusalem. I have seen no examples from Transjordania or from the Jordan Valley and doubt whether it occurs there, since in Lebanon it seems to be confined to the western slope. It is not uncommon at Beirut and Sidon on the coast of Syria in II. and III., but seems less frequent in the mountains than in Palestine.

The Cypriot form resembles *phoenissa* in some respects, but I am not sure whether it is not really a transitional race between *phoenissa* and the Mediterranean *meridionalis* Vrty.

Variation. v. Kalchberg's remarks on *phoenissa* should be studied. The subspecies, as he points out, is distinguished by a very constant combination of characters, small size (I have specimens with fore-wings of barely 15 mm. in length), extremely open greenish reticulation on the underside hind-wings, with large white spaces and considerable yellowish suffusion on the edges of the white spaces, marked development of white chevrons at the extremity of the nervules in the apical area on the upperside fore-wings, etc. He points out that another feature of this race is the great frequency of individuals of the form *umbrosa* Culot, or transitional thereto. I have magnificent examples of this individual aberration from Beirut 28.III. 1922, and others only less marked from Haifa. Out of 43 ♂♂ of *cardamines* from Palestine before me, 27 show to a greater or less extent the dark scaling dividing the orange apical area from the white field of the fore-wing which is characteristic of this aberration. This character is worth noting, as showing the prevalence of a type of variation peculiar to a genus in a particular area; cf. the Ain Zahalta and Aleih race *syra* Vrty. of *A. damone*, and subspecies *armeniaca* of *A. gruneri*, which also occurs in several parts of Syria and in Eastern Asia Minor.

53. **Anthocharis gruneri** H.-S. subsp. ?

Herrich-Schafer, i, figs. 551–554. Text in Suppl. gives "Crete" as locality of the nymotypical form, which is almost certainly inaccurate, the species having never been found there. Freyer, 575, figs. 1, 2, gives "Amasia."

Distribution and Dates. Apparently very local and uncommon about Jerusalem, where it was first recorded by Swinton, who mentions the capture of a ♀ of "*armeniaca*." I have only two Jerusalem specimens before me, both taken by Dr. Buxton, nr. Jerusalem 13.III.1922 and at Kolonia 20.III.1921 respectively. Taken nr. Ain Sinia e.IV.1918 and there reported more frequent (specimen in Mus. Min. Agr., Cairo).

Variation. One of Dr. Buxton's specimens and the specimen from Ain Sinia are subspecies *armeniaca*, Christoph, Iris, vi. p. 86 (1893), from Armenia, Southern

Asia Minor and Mesopotamia (Mardin district). But more material is required before the Palestine race of this species is definitely determined.

54. **Zegris eupheme** Esp. subsp. **dyala** Peile.

Peile, Journ. Bomb. N.H. Soc., xxviii, pp. 353–354, figs. 1, 2. "Dyala River, Iraq."

Distribution and Dates. This fine species is very local in Palestine, occurring only, so far as it has been recorded, in the Jordan Valley, where it appears in March and possibly earlier in favourable seasons. At Jericho 17–21.III.1921, also 8.III.1922 (P.P.G.), on the steppe at the foot of the hills due west of the town and on the hill slopes. Also at Mar Saba Monastery in the valley of the Wadi Kelt, west of Jericho (III., P.A.B.). It has a strong flight, settles during cloudy spells on the ground, and is by no means easy to capture. A somewhat worn ♂ was taken at Asluj about 10 m. south of Beersheba on 8.III.1923 by Major Lockhart, and is in the Hemming Coll.

In Transjordania it has been taken by Mr. H. St. J. Philby at Petra (3.500 ft.) 19–31.III.1923. Also recorded from the Tullul-es-Safa, N. Hauran, Syria, by Stgr.

Variation. The form from Jericho and Mar Saba is *dyala* generally with somewhat heavier greenish-yellow and rust-coloured marking on the underside hind-wings than Peile's captures in Iraq, but resembling *dyala* in essentials, *e.g.* the absence of sulphur-yellow suffusion on the white areas of the underside hind-wings and the great restriction of such suffusion on the underside of the apical area of the fore-wings.

At Petra occurs a form which, to judge from six specimens taken by Mr. Philby, is intermediate in some cases between *dyala* and the race from parts of Asia Minor and W. Kurdistan, *mencstho* Menetries. The Asluj specimen is rather small and also an intermediate. The race from Jericho is the largest which I have seen.

55. **Teracolus fausta**, Olivier, subsp. **fausta.**

Olivier, Voy. Emp. Oth., Pl. 33, figs. 4*a*, *b* (1801)—figs. from Sinai specimens.

Distribution and Dates. A migratory species, *T. fausta*, appears first at the end of VI. or a little earlier in the Coastal Plains. Swinton gives 13.VII. as the earliest date

at Jerusalem, but others seem to have noticed it earlier on the Plateau. Once having entered the country it rapidly overspreads all areas where its food-plant, *Capparis spinosa*, grows and becomes very common until the rains. A search in the Jordan Valley and the Dead Sea region in spring would probably reveal its presence there, and among Mr. Philby's specimens is one bearing the most interesting date "Petra, 19.III.1923." In Egypt it appears in small numbers in the Wadis nr. Heluan in May. I saw a specimen in bad order as late as the second week of December at Umm el Kilab in 1917, but this was the only one which I ever saw in the steppe. It is generally frequent during its long flight period, and probably has three generations during the four to five months of its appearance. Occurs in Transjordania to over 3,000 ft. Petra, Wadi Zarqa Main 5 and 28.X.1923, Amman, September 1907, Wadi Sir and Fuhais m.VIII.1923. In Arabia, Sinai, Syria, on coast at least as far as Tripoli, Iraq, Persia.

Variation. The ♂♂ vary little except in size, dwarf specimens occurring among the others. The ♀♀ vary at times in the extent of the black apical pattern on the upperside fore-wings and more rarely in the ground-colour, which, however, does not appear ever to be as yellowish-orange as in Indian specimens and in some which I have seen from Iraq.

56. **Teracolus phisadia** God. subsp. **palaestinensis** Stgr.

Staudinger, Iris, x, pp. 271–272, 1897. Ain Jiddi (Engeddi) and Ghor-es-Safieh (Safi).

Distribution and Dates. A local species obviously of Ethiopian origin, being a variant of *T. phisadia phisadia*, which is also Palaearctic, occurring in the Sinai Pen. It was figured by Klug as *arne* from "Ambukohl," N. Sudan and Arabia Deserta, *i.e.* presumably the Sinai Pen. Subspecies *palaestinensis* was discovered at Ain Jiddi on the Dead Sea in XII.1896 by Herr Bacher, who afterwards took fresh specimens in the second half of February 1897 in the Ghor-es-Safi at the south end of the Dead Sea. It was taken there by Mr. Philby 3.XII.1923. A 2nd (?) Gen. of *T. phisadia* occurs in the Wadi Fara and near the "Abyssinian village," Jordan Valley 6.VIII. and 7.VIII. Hemming Coll.

My only specimen from nr. Akaba was taken there with

others by Herr Guyot in April. He believed the species to be associated with *Salvadora persica*. It is *T. phisadia phisadia*.

Variation. *Palaestinensis* differs from the nymotypical form in having the underside hind-wings suffused with pinkish-brown instead of being yellowish-green. But some of Mr. Philby's specimens are transitional to typical *phisadia*, the suffusion being only partial. The (?) 2nd Gen. specimens from Wadi Fara and the Jordan Valley in the Hemming Coll. are very small, mostly under 37 mm. in expanse and with very bright yellowish-green undersides.

57. **Teracolus chrysonome** Klug. subsp. **chrysonome.**

Klug, Symb. Phys., Pl. VII, figs. 9–11. "Ambukohl" (N. Sudan).

Distribution and Dates. First taken in the Palaearctic region in the Ghor-es-Safi in the second half of February 1897 in association with the preceding species. Also taken there by Mr. Philby on 3.XII.1923. Occurs in the Sudan and Arabia. Another Ethiopian species with an even more restricted Palaearctic distribution than *T. phisadia*.

Variation. There is a marked difference in the depth of the green ground-colour of the underside hind-wings in the specimens taken by Mr. Philby.

(It is possible that another species of *Teracolus*, *T. eupompe*, which has been reported from the Sinai Pen. occurs in the Ghor-es-Safi.)

(*Catopsilia florella* occurs occasionally, apparently as a migrant, in Lower Egypt, and I have seen it at Suez. I have also seen it at Akaba, e.V.1918. Staudinger gave Syria as one of its Palaearctic habitats in his Catalogue (3rd Ed.), but I have seen no Syrian or Palestinian records. I should expect to hear of its occurrence in the lower Jordan Valley and in the Ghor-es-Safi.)

58. **Colias crocea** Fourcroy (**edusa** auctorum) subsp. **crocea.**

Ref. Fourcroy, Ent. Paris, ii, p. 250 (1785). "Paris."

Distribution. A widespread species occurring almost everywhere, though it was not seen in the sandy veldt south of Gaza between July and September, and was absent from the Plateau nr. Jerusalem in the spring, *i.e.* March, b.m. April, 1922, though it appeared there at the end of IV. It is sometimes frequent, especially in cultivated or semi-cultivated country where clover is sown.

Dates. Bir Salem, Ludd, etc. II.–IV., Jericho 17–22.III., Mt. Carmel b.III., nr. Jerusalem e.IV.1922, VI.1922, Beisan (♀ f. *pallida*) VII. are among my records, and during the summer and autumn months it occurs more freely in suitable localities and is probably continuously brooded in the damper parts of the Jordan Valley and Coastal Plain.

Variation. I have taken specimens of the (?) 1st Gen. nr. Bir Salem near Verity's 1st Gen. *vernalis*, and have seen large 2nd Gen. specimens on the way to his *ampla*. The largest *crocea* which I have seen anywhere occur among the 2nd Gen. specimens in June nr. Constantinople on both sides of the Bosphorus among more normal specimens. In Palestine and Transjordania the whitish ab. *pallida* occurs as elsewhere among normally coloured females. Among Mr. Philby's specimens is a very vernal ♂ from Ain Sara 26.XI.

59. **Gonepteryx cleopatra** L. subsp. **taurica** Stgr.

Staudinger, Hor. Soc. Ent. Russ., xv (1881), p. 65. "Taurus."

Distribution and Dates. Generally distributed and not infrequent on the Plateaux, also on Mt. Carmel and occasionally on the Coastal Plain, *e.g.* Ludd b.IV.1918 (P.P.G.). I have seen no specimens from the Lower Jordan Valley or Transjordania. The species has certainly two generations in Palestine. Gen. I appeared on 13.II.1922 at Jerusalem (P.P.G.), ♂♂ and most ♀♀ were worn at Haifa 5–11.III.1921 (P.P.G.), while a 2nd Gen. appears in the early summer, *e.g.* Jerusalem 19.V.–2.VI. (Swinton). I have no evidence of a 3rd Gen.

Variation. Staudinger (*loc. cit.*) describes *taurica* as "larger," presumably than the *cleopatra* of S. Europe. This is not generally the case in Syria (Beirut, Lebanon) and Palestine. No ♂ of a fairly long series in my Coll. exceeds 30 mm. in length of fore-wing. The largest *taurica* I have seen is a fine ♂ from Rhodes sent me by D. Charnaud with fore-wing length of 32·5 mm. The subspecies differs from the S. European and N. African forms in having a paler, less clear cut and often smaller area of orange-red scaling on the fore-wings of the ♂. ♀♀ of the 2nd Gen. have the underside of the hind-wings lighter and yellower in ground-colour than those of the 1st Gen.

DANAIDAE.

60. **Danaida chrysippus** L. subsp. **chrysippus.**

Linné, Syst. Nat., Ed. X, p. 471. "Egypt."

Distribution and Dates. Haifa (v. Kalchbg.) nr. Jaffa, in Jordan Valley, *e.g.* Jericho m.III.1921 (P.P.G.), Beisan VII. and later. Ghor-es-Safi 3.XII.1923 (Philby), and elsewhere on Dead Sea. Reported from Gaza and Athlit. Probably occurs in numerous suitable localities on the Coastal Plain. Locally frequent nr. Beirut. Occurs in Cyprus, near Smyrna (? migrant), formerly at Phaleron nr. Athens, Missolonghi in Greece (Fountaine) and in Egypt, where it is frequent everywhere. In that country and in the Jordan Valley it seems to be continuously-brooded. An immense tropical distribution.

Variation. Trans. ad *alcippus* reported from Haifa (v. Kalchbg.), f. *dorippus* reported by him to be rare there.

Food-plant. Calotropis procera ("Oshr") in the Jordan Valley.

NYMPHALIDAE.

61. **Melitaea arduinna** Esp. subsp. ?

Esper, Pl. LXXXVI, fig. 4. "Kamyshenka, Volga Region."

Distribution and Dates. Among the Melitaeas received by the B.M. from Mr. Philby are two very large ♀♀ which appear to belong to this rare and local species. They present the same special characteristics that separate the various forms of *arduinna* from Croatia, Russia and Central Asia in the B.M. from *M. phoebe*, viz. :—

A. Upperside fore-wing :—

1. The first four spots of the row which starts from the costa of the fore-wings beyond the cell apex in the direction of the tornus and turns sharply inwards more or less in line with the posterior edge of the discoidal cell after the fourth spot are in the same alignment. In *M. phoebe* the first pair of spots starting from the costa are not in the same alignment as the second pair.
2. The chevrons of the submarginal band in interspaces 2 and 3 on the upperside of the fore-wings do not project basad in such marked salients as in *M.*

phoebe, but are very slightly advanced from the alignment.

3. Of the four spots in interspace 1*b* and 1*c* which are situated on the proximal side of the submarginal row, if and when that row is present, the first, *i.e.* the fourth from the base and last counting from the costa of the row mentioned in (1), is usually sagittate and points towards the base, while the second, *i.e.* the third from the base, is nearly always sagittate but is smaller, and points towards the distal margin. The two spots resemble two arrow-heads each pointing towards the other thus : >< . In *M. phoebe* the first spot, if angulate, points towards the distal margin. It usually has a rectangular or slightly curved outline.

B. Upperside of hind-wing.

4. The interspaces between the submarginal row of chevrons pointing inwards from the distal margin and the inner band contain a row of more or less circular black spots in the same fulvous area as in *Melitaea cinxia*. Very occasional specimens of *M. phoebe* have faint spots in this area, but they are almost always extremely small and indistinct. Another character quoted by Rühl-Heyne as distinctive of *arduinna*, viz. the bright orange-yellow palpi, is present in the fresher of the two specimens in question, but can only be of value in the determination of very fresh specimens.

These two ♀♀ were taken by Mr. H. St. J. Philby on the Jebel Suwada nr. Salt, Transjordania, 19.IV.1923 (*circa*. 4,000 ft.). The freshest is of a colour nearly answering to Ridgway's "orange cinnamon" ("Colour Standards," Pl. XXIX). The other is somewhat worn and more ochreous. Length of fore-wing 25·0 mm. in the first-mentioned specimen, 24·8 mm. in the other.

62. **Melitaea phoebe** Kn. subsp. **telona** Frühst.
nova subsp. **dorae**, mihi.

Frühstorfer, Int. Ent. Zeitschr., i, p. 310. "Jerusalem." Nova subsp. *dorae* subtus descripta.

Distribution and Dates. *M. phoebe telona* is fairly wide-

spread on the Palestine Plateau from Galilee to Judaea, and also occurs at Mar Saba among the foothills above the Jordan Valley. To judge from specimens taken by Mr. Philby it also occurs in the more northern part of Transjordania. The 1st Gen. appears as early as mid-March at Mar Saba and is to be found in April on the Plateau, ♀ specimens being on the wing well into May. I have seen no 2nd Gen. specimens from Palestine. In the Beirut Coastal District in Syria a 2nd Gen. appears in late VI. and early VII., and M. Cremona, a local collector, informed me that there was a 3rd emergence in early IX. *M. phoebe telona*, from which *M. phoebe almana* Rbl. from the Elma Dagh in N. Syria appears to differ only slightly, occurs right through Syria into Cilicia (*almana*), but in Asia Minor occur darker and also more variegated races.

Subsp. **dorae**, *mihi.*

Prefatory. The description of most of the Melitaeas is not an easy matter, the intricacy of the network of black lines and spots on various shades of fulvous making it difficult to give a comprehensible account of a specimen without a figure. In the following description of a new subsp. of *M. phoebe* I have endeavoured to be as clear as possible, and consequently before embarking upon the description, give a summary of the upperside wing-markings of *M. phoebe* in most of its better-known forms.

Dark marking of fore-wing. In the Western races of *M. phoebe* with which the new subsp. is compared the following are the dark markings on the upperside of the fore-wings :—

(*a*) A dark marginal distal border inwardly slightly crenelate.

(*b*) Surmounting this border, and connected therewith by the submarginally black nervules, a band of intra-nervular black chevrons of varying width and enclosing fulvous scaling which in highly suffused (melanistic) aberrations disappears completely. In interspaces 2 and 3 the chevrons are produced basad in marked salients, which brings their apices out of line with the apices of the rest. The chevron in interspace 2 is almost always well or fairly well marked. It is not produced so far basally as that in 3, which is generally less heavily

marked than that in 2. The apex of this chevron comes into line with—

(*c*) The second submarginal band, which starting from the subapical costa is produced curving distad in the direction of the posterior (anal) margin, and is strongly marked in most cases from the costa to interspace 5. In and after interspace 4 it deviates from its course slightly basad, and in all the less heavily marked races is broken into a series of linear spots which are often small and indistinct and sometimes absent in interspaces 4 to 2 inclusive, but fairly well marked in 1*b*, 1*c*.

(*d*) There follows the third submarginal band. This is composed of spots, more or less fused in the darkest races and aberrations on a varying extent of its course. This band starts from the costa beyond the cell apex. The first four spots in interspaces 4–8 are arranged in two pairs, the two in 6–8 being in a different alignment to the pair in 4, 5. The band then turns sharply more or less in line with the posterior edge of the discoidal cell through interspaces 3, 2, and terminates in a spot in interspace 1*b* and 1*c*, set nearer the distal margin than that in 2. This spot is circular, or rectangular, or distally convex, or sagittate. This band in the lighter races is composed of relatively widely separated spots, which are linked up by dark scaling to a greater or less extent in the darker races. Proximally there are dark bars across the cell and basal and sub-basal dark spots, the sub-basal spot in interspace 1*b*, 1*c* often containing fulvous scaling as in *M. didyma* and other Melitaeas.

Dark marking on hind-wing. Here again one finds the same general pattern :—

(*a*) Dark slightly crenellated margin.

(*b*) Submarginal chevrons.

(*c*) A band of linear spots, sometimes fused so as to form a continuous dark line, sometimes but faintly marked.

(*d*) The third submarginal row of spots of varying size, usually more or less circular, with black proximal lines and spots.

(*c*) Abdominal fold more or less suffused with black scaling.

(Very rarely one finds examples in which the fulvous ground between (*b*) and (*c*) contains black spots within the interspaces (ab. *cinxioides*).

Ground-colour and Size. The ground-colour varies from yellowish-fulvous through tawny to a bright orange-tawny, and in several races two shades of fulvous, a lighter and a darker, are conspicuously present. Such a race is *ornata* Chr. from the South Ural. Other races are of a more uniform colour; such is *telona*, a small lightly marked subspecies. Size (in the 1st Gen.) is another character separating races. As the larva feeds up before pupation in spring one would have expected the race from Brusa and the Marmora basin to be larger (on account of the greater vernal rainfall) than the race from Attica (*ogygia* Frühst.), but it is not.

Description of new subsp. **dorae.**

Size. A rather small race larger than Beirut *telona*. Length of fore-wing usually from 20 to 21·5 mm. in the ♂ and from 22 mm. to 23 mm. in the ♀.

Ground-colour. Very uniform as is the case in *telona*, when fresh usually "tawny" to "ochraceous-tawny" (Ridgway, "Colour Standards," Pl. XV) in the ♂ and "ochraceous-tawny" in the ♀.

Upperside fore-wings :—

(*a*) The dark margin is much reduced in depth and in some specimens contains traces of fulvous, while in others the fulvous ground-colour reaches the termen, breaking up the marginal band into separate spots in interspaces 2 and 3.

(*b*) The submarginal chevrons are lightly marked, and sometimes absent in one interspace or more from interspace 1*b*, 1*c* to and including interspace 3 and sometimes interspace 4.

(*c*) The second submarginal band is only prominent and in most specimens only visible from the subapical costal margin to and including interspace 5, the spot in interspace 1*b*, 1*c* small, sometimes absent.

(*d*) The third submarginal row of spots and basal markings as in *telona*.

Upperside hind-wing :—

(*a*) Black margin narrow, often containing fulvous lightenings.
(*b*) Submarginal chevrons very thinly marked.
(*c*) Second submarginal band entirely absent or very faint.
(*d*) Third submarginal row of circular spots often incomplete.
(*e*) Abdominal fold only suffused and then slightly at its proximal extremity.

Upperside of ♀. *Mutatis mutandis* as in the ♂, the second submarginal bands on both wings being no more prominent, the spots of the third submarginal row of the hind-wing being slightly larger relatively, and the dark suffusion and marking thence basad less than in *telona*.

Underside of both sexes. Black marking less extensive on fore-wings than in even *telona*. Hind-wings as in *telona*. To sum up, a very markedly "dry" form of *M. phoebe* of moderate size and uniform ground-colour distinguished by the greatly reduced black marking of the upperside from any other race of *phoebe*. The only specimens which approach it to my knowledge are some of the subspecies *scotosia* in the B.M. from Japan and Korea, and *aetherie* from Andalusia in the same collection, but *aetherie* is a very different insect, possibly an altogether separate species.

Described from 13 ♂♂ and 3 ♀♀, taken in the last half of March 1922 and 1923 at Petra in Nabataea (3,100 ft. approx.) by Mr. H. St. J. Philby, and now in the B.M. An unfortunately worn and rather damaged ♀ taken at Kerak in Moab by Mr. Philby 8.V.1923 seems to belong to this race. The second generation is unknown. The race of Northern Transjordania, to judge from two specimens taken on the Bir Ayub Road 21.IV. and a ♂ from Rusaifa, is *telona*. The only 2nd Gen. *phoebe* which I have seen from Transjordania (or Palestine) is a dark rather worn ♂ specimen taken at Wadi Sir 14.VIII.1923.

Subspecies *dorae* is named after Mrs. H. St. J. B. Philby.

(Note.—To give an idea of the extent to which the new subspecies differs from *telona* and other forms I have prepared a scale of nigrescence, giving each specimen a number signifying the extent of the black scaling of, in the fore-

INDEX OF NIGRESCENCE OF M. PHOEBE RACES (UPPERSIDE).

Maximum.	Fore-wing. (a) 10	(b)&(c) 10	(d) 10	Hind-wing. (a) 10	(b) 10	(c) 10	(d) 10	(e) 10	Total. 80
Melitaea phoebe dorae, range 15·5 to 27, approx. average 22.									
Locality.									
Petra No. 1 ♂	3	4	4	4	3	0	4	1	23
,, ,, 2 ♂	2	2	4	3	2	0	4	1	18
,, ,, 3 ♂	3	2	4	3	2	1	3	1	19
,, ,, 4 ♂	4	2	4	5	1·5	0	4	1	21·5
,, ,, 5 ♂	4	3	4	4	2	0	4	1	22
,, ,, 6 ♂	1·5	1	4	3	1	0	4	1	15·5
,, ,, 7 ♂	3	4	6	2	1·5	1	3	1	21·5
,, ,, 8 ♂	4	4	6	2	2	1	5	1	25
,, ,, 9 ♂	4	4	4	3	2	1	6	1	25
,, ,, 10 ♂	2	5	4	3	4	1	2·5	1	22·5
,, ,, 11 ♂	1·5	4	4	3	3	2	1·5	1	20
,, ,, 12 ♀	2	2	4	6	3	3	6	1	27
,, ,, 13 ♀	2	4	4	3	1·5	1	4	1	20·5
,, ,, 14 ♂	4	2	5	4	3	1	5	1	25
,, ,, 15 ♂	2	3	5	2	2	0	3·5	1	18·5
,, ,, 16 ♀	5	4	4	5	2	3	2·5	1	26·5
Melitaea phoebe telona, range 23·34·5, approx. average 30.									
Transjordan No. 1 ♂	5	6	6	5	5	1	4	1·5	33·5
,, ,, 2 ♂	3	3	4	4	3	2	3	1	23
,, ,, 3 ♂	4	5	6	4	4	3	6	1·5	33·5
Mar Saba No. 1 ♂	6	4·5	4	6	4	2	4	2	32·5
,, ,, 2 ♂	6	5	4	6	4	4	6	1	36
,, ,, 3 ♂	5	4·5	4·5	5·5	4	2	4	2	31·5
Judaea No. 1 ♂	3	3	4	4	3	3	3	1·5	24·5
,, ,, 2 ♂	4	4	4	4	3	3	4	1	27
,, ,, 3 ♂	5	6	4	4	2·5	4	6	1	32·5
,, ,, 4 ♂	2	4	4	4	2	3	4	2	25
,, ,, 5 ♂	5	4	5	4·5	2	3	5	1	29·5
,, ,, 6 ♂	6	4	6	4	2	2	4	1	29
Beirut No. 1 ♂	4	5	4·5	4	4	4	4	1·5	31
,, ,, 2 ♂	3·5	5	4	4	4	2	2·5	1·5	26·5
,, ,, 3 ♂	4	5·5	6	4	5	5	4	1	34·5
Melitaea phoebe ogygia, range 28–47, approx. average 36.									
Athens No. 1 ♂	5	3	4	5	3	5	2	1	28
,, ,, 2 ♂	5	6	4	6	5	5	3	2	36
,, ,, 3 ♂	3·5	5	5	4	4·5	5	3·5	2	32·5
,, ,, 4 ♂	5	6	5	4	5	5	4	2	36
,, ,, 5 ♂	5	7	7	6	6·5	6·5	5	4·5	47
,, ,, 6 ♂	5	7	4·5	6	5	5	3	2·5	37·5
A ♂ *Melitaea phoebe* from the Engadine in B.M. ex-Elwes Coll. the lightest of a series for comparison.									
Engadine ♂	6·5	7·5	6·5	6	6	6	7	4·5	50
Approximate average of nigrescence :—									
race *dorae*	2·93	3·12	4·44	3·46	2·21	0·93	3·87	1·00	=21·96
,, *telona*	4·36	4·56	4·63	4·46	3·43	2·86	4·23	1·36	=29·89
,, *ogygia*	4·75	5·66	4·91	5·16	4·83	5·25	3·41	2·33	=36·30

wings, (*a*) margin, (*b*) and (*c*) first (chevrons) and second submarginal bands, (*d*) third submarginal row of spots and dark markings proximal thereto, and on the upperside of the hind-wings, in (*a*), (*b*), (*c*), (*d*) and in (*e*) abdominal fold. A minimal quantity of dark marking is signified by 1, a maximal by 10. An entirely suffused black specimen would therefore have an index figure of nigrescence of 30 for the fore-wings (the dark marking of the first submarginal band of chevrons and of the second submarginal band being counted as a single unit) and of 50 for the hind-wing. This is, of course, a very arbitrary method of arriving at an estimate of comparative nigrescence, but I feel that it may be developed and may help to differentiate races of *phoebe* and perhaps of other species of *Melitaea*.)

63. **Melitaea didyma** Esp. subsp. **deserticola** Obth.

Oberthür, Études, vol. i, p. 25, Pl. III, fig. 1. "Biskra."

Distribution and Dates. *M. didyma*, although abundant in early summer in the Lebanon and Anti-Lebanon, seems rare in Palestine. It is possible that low-ground conditions in a subtropical climate have only been overcome by the specialised race *deserticola* of this species, which has a somewhat different larva and is a very local desert insect. The Lebanon race or races in their 2nd (dry) Gen. make some approach to *deserticola*, to judge from a few specimens taken by me in early VIII. on the Jebel Zahalta. The few specimens I have seen from Palestine are either *deserticola* or near it, though I may remark, firstly, that Eastern *deserticola*, *i.e.* the form from the desert east of Cairo, where it appears in III.–V. and again in X., from Aqaba (Akaba) and from Palestine and Transjordania, sometimes differ slightly, notably in having rather more dark marking on the underside hind-wings, from the *deserticola* of Southern Algeria; secondly, that in the Mus. Min. Agr., Cairo, there is an Egyptian ♀ of *deserticola* which is transitional to the ♀ of the South-east European race *meridionalis*. The only Palestinian localities from which *didyma* have been sent me are Mar Saba Monastery 15.III. and Ain Karima 23.IV. (both P.A.B.). Von Kalchberg's record of "a few *didyma persea* Koll." from Haifa is rendered doubtful by the discovery made by Riley that *persea* is a subspecies of *trivia*. In Transjordania it occurs on the Jebel Suwada nr. Salt, whence Mr. Philby sent a

fine pair to the B.M. dated 19.IV., and more doubtfully on the Bir Ayub Road 21.IV., a ♀. This last specimen may however be *trivia pseudodidyma* ♀. I have also before me a ♂ taken at Wadi Sir, Transjordania 14.VIII., the only one of this generation which I have seen from this part of the Near East and markedly *deserticola*.

Variation. With such limited material it is impossible to lay down the law concerning the variation of this most plastic species in Palestine. I am the less tempted to do so on account of my experience with *bosphorana* Culot. This 2nd Gen. form was described from the Bosphorus near Constantinople from some thirty specimens, and I had expected it to be a regular second-brood form there. This was not the case. Though I collected *didyma* assiduously on both sides of the Bosphorus from 1911 to 1914 and from 1919 to 1922, and amassed a long series containing every local variation which I could catch, I do not think I took half a dozen *bosphorana* after 1911. I can therefore only suppose that this was simply an aberrant form which through the happy survival of an exceptionally large number of aberrant parents or special climatic conditions was quite common in the autumn of one year. I will therefore only remark that the two specimens from Jebel Suwada are very singular. The ♂ has the pale ground-colour of *deserticola* and its lack of black marginal marking on the upperside, but across the hind-wings run four rows of relatively large and often circular black spots, giving the specimen a most unusual appearance. The female is exceptionally large, fore-wing 26 mm. The upperside is light-coloured and lightly marked, but the underside of the hind-wings is heavily marked with black.

64. **Melitaea trivia** Schiff. subsp. **syriaca** Rbl., subsp. **persea** Koll., subsp. **pseudodidyma** Rbl.

Subspecies *syriaca* Rebel, Ann. Hofm. Wien, xx, p. 194. "Beirut and Haifa." Subspecies *persea* Kollar, Ins. Pers. in Akad. Wiss. Wien, i, p. 50, 1855. "Persia." See also Peile in Journ. Bomb. N.H. Soc., xxviii, pp. 147, 148, figs. 7, 8, 12. Subspecies *pseudodidyma* Rebel, Ann. Hofm. Wien, xx, p. 194. "Nr. Kaiseri S.E. Asia Minor."

Distribution. Fairly general in subspecies *syriaca* on the Plateau, reaching the coast at Akka and Haifa, but apparently absent from parts of the Coastal Plain. Thus I never saw it or took the larva nr. Ramleh and Ludd in 1918, although

its food-plant (*Verbascum thapsus*) abounded. Subspecies *persea* occurs in an exaggerated form, to judge from specimens taken by Dr. Buxton at Mar Saba Monastery in the foot-hills above the Jordan Valley. In Transjordania occurs a form which differs in no essential characters from *pseudodidyma* Rbl. In the B.M. are specimens from various localities, *e.g.* Salt, 18.IV., Bir Ayub Road 21.IV., Petra 16.III., taken by Mr. H. St. J. Philby. Frequent at Beirut and widespread in Lebanon to at least 4,500 ft.

Dates. 1st Gen. III.–IV. according to level, *e.g.* Haifa 17.III. (Herzog), Tulkeram 29.III. (Hemming Coll.). 2nd Gen. from VI. to m.VII. (Akka e.19.VI.–17.VII., P.A.B.). At Beirut a 3rd Gen. or a second part of the 2nd Gen. occurs in late August and September. The Mar Saba specimens were taken by Dr. Buxton 23.IV.1922, quite possibly a 2nd Gen. given the torrid heat of April in the Valley. Transjordanian dates are given under "Distribution." I have seen no 2nd Gen. specimens from Transjordania.

Variation. Palestine *trivia* except the Mar Saba specimens are *syriaca* Rebel. The small specimens of the 2nd Gen., which decrease in size the later they emerge in summer, often expand no more than 26 mm. They bear the same relation to *syriaca* Gen. I that Esper's figs. of *phoebe* = *nana* Stgr. from Sarepta bear to the 1st Gen. *fascelis* from that locality. I take this opportunity of raising the question of the application of the name *nana* (Stgr., Cat. II, p. 18) to the small 2nd Gen. *trivia* of other races than *fascelis*. Staudinger describes *nana* simply as "v. et ab. *nana*, minor," and gives "South (European) Turkey" as its habitat. He quotes Esper's Plate 88, figs. 5, 6, where the 2nd Gen. of *fascelis* is depicted under the name of *phoebe*. "Minor" is quite an inadequate description of some of the 2nd Gen. races of *trivia* or its subspecies from many parts of the Near East, and Rebel has suggested (Ann. Hofm. Wien, xx. p. 194) that the name should be merely applied to dwarf summer specimens as an aberrational name, not as the name of a geographical subspecies. If *nana* is to stand as a seasonal qualification it should be applied, because of Staudinger's mention of Esper's fig., only to the 2nd Gen. of *fascelis*. The race occurring in South Turkey is not true *fascelis*, in my opinion, in the 1st Gen., but a transitional form between

it and *trivia*. If the description is regarded as insufficient, then it would be best to employ the hyphenated adjective *secunda* (respectively *tertia*) for the later generations of the races of *trivia* in order to avoid the multiplication of names.

Though less variable than *M. phoebe* and *didyma*, *M. trivia* is a very plastic species which follows similar directions of variation to those of its congeners under climatic rather than geographical influences. The darkest *fascelis* come from the rainy Rilo and Rhodope Mtns. Subspecies *persea*, the lightest form of any, comes from the parched hillsides of Iraq and Persia. Dry heat is associated with a paler tawny ground-colour and a decrease of the dark marking on the upperside. The races and Gens. of *M. trivia* from Spain to Turkestan are a series of grades along a single line of variation from the extreme *fascelis* (wet form) of the rainy Rilo and Rhodope Mtns. to the extreme *persea* f. *secunda* from the tropical canyon of Mar Saba and the parched hills of Iraq, an exaggerated "dry" form. Russian *fascelis* are "wet," but less so than those from the Bulgarian Mts. After these come the transitional race from Macedonia, the Marmora Region, etc., and the nymotypical race from Hungary. The Spanish race, of which there is one specimen in the B.M., appears to be a "Middle form" combining light leather-yellow ground-colour with fairly abundant but clearly defined and unsuffused black marking. *Pseudodidyma*, with which the race from Transjordania (1st Gen.) agrees fairly well according to Dr. Rebel, is a Middle form, with fairly heavy but clearly defined dark marking, brighter colour than the Spanish and Syrian races, heavily chequered fringes and in some specimens a decided resemblance to *didyma*. I may note here that I have found Riley's discovery that the midmost of the three black markings on the underside of the hind-wing in each of the interspaces 2 and 3 between the orange bands is nearer to the distal band in *trivia persea*, but nearer to the proximal one in *didyma casta*, to be applicable and valuable as a determining character in the case of Transjordanian and Palestinian specimens. *Syriaca*, *catapelia* and *persea* are "dry" forms and their 2nd (resp. 3rd) Gens. are "drier" still.

One might arrange the races of *triva* as follows, lightening of ground-colour and diminution of dark upperside marking from above to below.

1st Gen.	Later Gens.
1. *fascelis* from Rilo.	? single-brooded.
2. *catapeliodes* Stauder, from S. Italy.	? 2*a*. trans. ad *catapelia* (Italy, Verity).
3. *fascelis* from S. Russia.	3*a*. "*nana*" = *fascelis* f. *secunda*.
4. trans. race from Macedonia, Brusa, C'ple., etc.	4*a*. 2nd Gen. of trans. race.
5. *trivia* from E. Cent. Europe.	5*a*. *trivia* f. *secunda*.
6. *pseudodidyma*, S.E. As. Min. and Transjordania.	
7. Spanish race ?	
8. *catapelia*, Turkestan.	8*a*. *catapelia* f. *secunda*.
9. *syriaca*, Syria, etc.	9*a*. *syriaca* f. *secunda*.
10. *persea*, Palestine (part), Persia, Iraq.	10*a*. *persea* f. *secunda*.

I am not acquainted with the 2nd Gens. of Nos. 6 and 7, and do not know whether they have been described. In Italy *sec.* Verity occurs a 2nd Gen. race which is transitional to *catapelia*, but it is not certain that this is the 2nd Gen. of Stauder's *catapeliodes*, which he describes as a very dark race, darker than Russian *fascelis*.

65. **Polygonia egea** Cr. subsp. **egea.**

Cramer, Pap. Ex., Pl. LXXVIII, figs. *C.*, *D.* "Constantinople, Smyrna."

Distribution and Dates. Generally distributed on the Plateau, but most frequent in the neighbourhood of old stone walls, ruined buildings, etc., on which its food-plant (*Parietaria*) grows. It does not appear to occur everywhere in the Coastal Plain, being absent from large stretches of flat tillage or fallow where rocks are absent, and I have no record from the Jordan Valley, Jericho, Ghor-es-Safi, etc. It occurs in Transjordania (Amman, VIII., Philby), and is widespread in Syria, occurring at a considerable height in the mountains.

The following dates may be recorded. Jerusalem, hibernated specimens IV.1922 (P.P.G.), fresh ♂, 14.IV. (P.A.B.), 10.V., 19.V.–16.VI., 15.VII. and 7.VIII. (Swinton).

The species hibernates, as do so many Vanessids, emerging in the early spring, ovipositing to produce a 1st Gen. in early summer, V.–VII. in Syria Palestine, e.V.–VIII. in the

Constantinople region. This in turn produces a 2nd Gen. which in the northern part of the Near East takes the form *j-album*; this 2nd Gen. (3rd appearance) is first seen in IX. at Constantinople and continues till the winter, when it goes into hibernation. In Palestine and Transjordania it would seem to emerge from VIII. onwards.

Variation. The hibernated *P. egea*, which appear in early spring in Palestine, do not seem to differ from the 1st Gen. On the other hand, an autumn specimen from the Cedars of Lebanon (6,600 ft.) in my collection and one taken there in early April by Dr. Buxton are both *j-album*, with dark unicolorous underside, as are fresh specimens taken in October at Constantinople. Gen. 2 *j-album* would therefore appear to be confined to the more northern or higher-lying parts of the Near East where hibernation is longer than in the southern or warmer areas, and in which the dark unicolourous underside would seem to have more protective value, cf. the undersides of *V. io*, *E. antiopa*, *A. urticae* and the *Eugonia* species. I may add that Dr. Rebel in his "Lepidopteren Fauna Kretas" (p. 105) states that his earliest *egea* from Crete are of the summer (*egea*) form, which suggests that *j-album* may also be absent from at all events the lower parts of Crete.

66. **Pyrameis cardui** L.

Linné, Syst. Nat., Ed. X, p. 475. "Sweden."

Distribution and Dates. This species is widely distributed in all parts of Palestine and Transjordania, occurring even in the most desolate spots, though there mainly as a migrant. Its numbers are frequently greatly augmented by immigration from the south and south-east, especially in the early spring. Thus in March 1921 *P. cardui* occurred everywhere in the Jordan Valley around Jericho, on the Plateau near Jerusalem, and about Haifa. Many of the specimens were worn and of small size, no larger than those which occur in Egypt in the late autumn and winter, and seldom exceed 30 31 mm. in length of forewing. The Jordan Valley and the Ghor are doubtless among the distribution centres from which swarms of this species move north. In 1921, after my return to Constantinople about April 10, I saw large numbers of *P. cardui*, mostly of the same small type seen in Palestine but even more worn and battered, flying about the neigh-

bouring country. Among them were many ♀♀, which were ovipositing on thistles. The year was certainly distinctly favourable for *cardui*, for great numbers of individuals appeared in June and July and again in the autumn. There are two broods at least in Palestine, or rather two main broods, one appearing in late spring and early summer, and the other in autumn, although fresh specimens, advanced or laggard, may be taken at almost any time between early March and November.

Variation. The *cardui* which I have taken in Egypt and Palestine are more often than not of a more uniform ground-colour, less rosy-brown than those taken further north, and of smaller size especially than the large early summer specimens taken in the more northern parts of the Levant.

67. **Pyrameis atalanta** L.

Linné, Syst. Nat., Ed. X, p. 478. "Sweden."

Distribution and Dates. P. atalanta, as in Egypt, is much rarer in Palestine than in Turkey (Constantinople) and Syria proper, but even in the latter countries it is much less frequent than it is in Great Britain and Central Europe. In Palestine I have seen it and taken and released damaged specimens at Khan Yunus near the extreme southern border at the end of December 1917, and Haifa, b.III.1921. I have also seen it near Jaffa and have heard of its occurrence nr. Jericho (Gauck. 18.III.1905) and Ramleh, but while it is doubtless widely distributed it is not common. Occurs in Transjordania, *e.g.* Ain Sara, 26.XI.1923 (Philby in B.M.). In Beirut it occurs in gardens, etc., in winter, but is, in my experience, seldom seen in the hot weather. In Egypt, where it occurs sparingly in Alexandria and near Cairo, it is usually seen between November and late April or early May. Nettles, it may be remarked, are not nearly such a feature of the flora of Egypt or Palestine as they are of more Northern countries, and while near Constantinople any ruined building or neglected shady corner of a fallow field is likely to shelter or contain a nettle patch, such localities are far less often nettle-infested in the Holy Land or the Nile Valley.

Variation. The Egyptian and Syrian *atalanta* which I have seen in other collections or taken myself are smaller than the British and Central European, but not inferior

in size to those from Turkey and Greece. Otherwise I can see no distinction.

68. **Limenitis rivularis** Scop. subsp. ?

Scopoli, Ent. Carniol., p. 165. "Carniola."

I have only one Palestinian specimen of this species taken by Mr. Buxton at Abu Ghosh on the Jerusalem-Jaffa Road, a village surrounded by olive groves nearly 2,000 ft. above sea-level, on 3.VI.1922. It is somewhat worn, and it is therefore impossible to say to what subspecies Palestinian *rivularis* belong till I have more material. I have been informed that it also occurs at Kolonia about 4 m. from Jerusalem in May. Swinton records it from Jerusalem. A rather small race occurs in the Lebanon, including Beirut, and in parts of the Anti-Lebanon. Also occurs in Cyprus.

(Note. Scopoli unfortunately figures *N. lucilla* as *Papilio rivularis*. One of his descriptions of the three forms of *rivularis* seems to refer to the insect now so called and formerly known as *camilla*. The others are not certainly identifiable from the description. It may be noted that *L. rivularis*, *L. camilla* (formerly known as *sibylla*) and *N. lucilla* all occur in Carniola.)

69. **Charaxes jasius** L. subsp. ?

Linné, Syst. Nat., Ed. XII, last page in *erratis*. "Barbary."

Distribution and Dates. This species is recorded by von Kalchberg from Haifa, and I have seen a somewhat damaged specimen of the 2nd Gen. which was taken there in September 1918 and is now in the Mus. Min. Agr., Cairo. Should be looked for on the Carmel range, especially wherever any relics of the old forest are left.

Variation. For lack of material I cannot say whether *C. jasius* from Palestine is the nymotypical Algerian race or is subspecies *septentrionis*, which occurs on the European shores of the Mediterranean. The species also occurs in Cyprus.

(The Apaturid *Hypolimnas misippus* has been taken not infrequently near Beirut in a locality where *D. chrysippus*, which its ♀ mimics, occurs. I have seen it in Egypt, where it is a rare immigrant from the tropics. Should be looked for in the Jordan Valley.)

SATYRIDAE.

70. **Yphthima asterope** Kl. subsp. **asterope**.

Klug, Symb. Phys., Pl. XXIX, figs. 15–18. "Syria, Arabia felix and Arabia deserta."

Distribution and Dates. Generally distributed though not in my experience abundant in Palestine, occurring on the Plateau as well as in the Coastal Plain and Jordan Valley. It also occurs at Beirut and much less frequently on the lower slopes of Mt. Lebanon, also in Cyprus (Kyrenia Pass) and south-western Asia Minor (Makri). In its warmer localities it appears by the third week in March, *e.g.* at Jericho 17.III.1921, and persists until December at Ghor-es-Safi, where Philby took specimens not all worn on December 3. It occurs in the valleys that seam the western face of the Transjordanian Plateau, and at Petra 21–28.III.1923. It would seem to have three generations, if indeed it is not continuously-brooded in low-lying localities. Swinton gives June as the month when he first noted it at Jerusalem.

Variation. The largest specimens before me come from Ghor-es-Safi. The number of ocellated spots on the underside hind-wings varies from 0 to 3 in my experience. Otherwise the species seems fairly constant.

71. **Pararge maera** L. subsp. **orientalis** Stgr.

Staudinger & Rebel, Cat. Pal. Lep., 1901, p. 61. "As. Min., Syr., Kurd., Arm."

Distribution and Dates. Absent as far as I know from the southern steppe, the Jordan Valley, and Transjordania, from which Mr. Philby brings no specimens, but pretty general on the Plateau, and, though not at all common, more often seen both there and in Syria proper than *P. megera*. I have specimens before me of the 1st Gen. from Jerusalem and Haifa, taken between the first days of March and late April. The 2nd Gen. appears in late May and drags on well into August, probably owing to the operation of the summer pause. Swinton gives 23.V.–17.VIII. as the dates of his first and last observations. At Beirut I have seen specimens late in August. I have no evidence of the existence of a 3rd Gen. in Palestine. There is certainly one in late IX.X. at Constantinople, where the 1st Gen. flies in May and a 2nd Gen. in July. This

3rd Gen. in Turkey is intermediate in appearance between the 1st and 2nd Gens.

Variation. Palestine (and Syrian) *maera* are still smaller than those from Eastern Thrace, Bithynia and Greece, which in my experience never approach the size of the large races from Southern France and the Iberian Peninsula. Palestine specimens agree with those from Syria in coloration, the 1st Gen. being distinctly nearer to the 2nd in appearance than is the 1st Gen. from Thrace, Bithynia, etc.

72. **Pararge megera** L. subsp. ? trans. ad **iranica** Riley.

Riley, Ann. & Mag. Nat. Hist., 1921, viii, p. 592. "N.W. Persia."

Localities and Dates. This species appears to be rare in Palestine. Neither Buxton, Swinton nor v. Kalchberg record it, and I have only seen one or two specimens at Cairo, which were taken at Ain Sinia high on the Plateau in late April or early May 1918. Kneucker records it from Bitter, 4.VI., a ♀. In Transjordania Mr. Philby took some specimens, mostly in bad order, at Petra in March 1923, which are now in the B.M.

Variation. I feel very diffident about these Petra specimens. They appear to be transitional between *lyssa* and *iranica*, but their condition is not sufficiently fresh to enable me to form a confident opinion. The dark bands crossing the underside of the fore-wings of the ♂ are very faint in some, as is the case with some specimens from Persia and Lebanon in the B.M. More material is required, if specimens from this very southern locality are to be definitely placed.

73. **Satyrus pisidice** Klug. subsp. **pisidice.**

Klug. Symb. Phys., Pl. XXIX, figs. 9, 10. "Higher parts of Mt. Sinai in September."

Distribution. So far only recorded from Haifa, whence von Kalchberg reports it, Tulkeram 20.X.1918 (Seabrook, Mus. Min. Agr., Cairo), and Gaza Dist. (Bell. in Hope Mus. Oxford). I have no doubt that it occurs elsewhere; I certainly thought I saw it with *S. fatua sichaea* about 300 ft. above the Jordan Valley at the end of April 1922 on the Jerusalem–Jericho Road when, for once in a way, I had no net. It occurs above Beirut, near Aleih and elsewhere, on the lower slopes of the Lebanon to about 3,000 ft., perhaps higher.

Dates. Zach, who first took it in the Lebanon, found it out in no great numbers in the first fortnight of July. The Haifa specimens which I have seen at Cairo were dated "September," and were worn. The Gaza specimen, a ♂, would seem to have been taken at the end of May, 1918.

74. **Satyrus fatua** Frr. subsp. **sichaea** Led.

Lederer, Wien. Ent. Mon., 1857, p. 91. "Beirut."

Distribution. In rocky country, ravines, etc., on the Palestine Plateau, where Miss Fountaine reports it to be widely distributed in early July. Haifa (von Kalchberg), nr. Jerusalem from 6.VIII. (Swinton); at about 300 ft. above the Jordan Valley in some numbers at the end of April 1922 on the Jerusalem–Jericho Road, flying with *H. thelephassa* and apparently *S. pisidice*. Not apparently uncommon in suitably rocky country, but absent from sandy and alluvial plains where there are no rocks. Syria, Cilicia.

Dates. From e.IV. in the tropical Jordan Valley, but elsewhere from e.VI. into VIII. as in most of its localities in Syria, where it abounds in the foothills of the Lebanon in the first ten days of July, and may be taken on the mountains up to at least 5,500 ft. later in the month and in early August. Stray females, usually much damaged, fly in September and even, I am informed, in early October.

Variation. There seems to be no difference between Palestinian and Syrian specimens of this fine race of *S. fatua*, though specimens from the Jordan Valley might be expected to show some variation, and a series from its foothills should be interesting. In Asia Minor and Macedonia, Greece, etc., where *S. fatua* occurs often on the same ground as its close relative *S. statilinus*, a careful study of these two allied species, or forms of a single highly variable species, is much needed, and might assist in throwing light on the relationships of the N. African species or subspecies *hansii, sylvicola,* etc., etc.

75. **Hipparchia persephone** Hb. subsp. **persephone.**

persephone Hübner. "No locality."

Distribution and Dates. The only record from Palestine which I have discovered is von Kalchberg's. He says that a few specimens were sent him from Haifa.

H. persephone occurs fairly frequently at medium and

high elevations in the Lebanon (at nearly 10,000 ft. on the Dahr el Khodib on August 30, 1910) and the Anti-Lebanon. It occurs at Damascus (2,500 ft.) and in the Hauran; it may therefore be expected in N. Transjordania. Occurs rarely in Cyprus (at high elevations on Mt. Troodos), and in parts of Asia Minor and S. Russia.

H. persephone appears in its warmer localities in May (*e.g.* Damascus 10.V.1901, Fountaine), and may be taken at medium heights in the Lebanon in good order as late as m.VII. (Ain Zahalta, 3,500 ft. 1904, P.P.G.).

Variation. The dimorphic female form *hanifa*, which has its parallel in the ♀ form *pirata* of *H. briseis*, occurs in the Lebanon and may be expected in Palestine with the type.

76. **Hipparchia thelephassa** Hb. subsp. **thelephassa.**

Subspecies *thelephassa* Hübner, Lep. Exot., ix, D, 3, figs. 1–4. No locality; also Klug, Symb. Phys., Pl. XXIX, figs. 1–4. "Syria."

Distribution and Dates. This species is the commonest and the earliest of the larger Palestine Satyrids occurring in the foothills and all over the Plateau from Dan to Beersheba from V. to VII. In the foothills above the Jordan Valley it is out in plenty by e.IV. (see under *S. fatua sichaea*). A small male specimen from Jebel Suwada, 9.V.1923, is among Mr. Philby's Transjordanian captures. I saw the species near Amman in late May 1905, and further south flying beside the railway on rocky ground not far from Jurf el Darwish Station on the Hejaz Railway in the same month. It is abundant in many parts of Syria, notably in the Lebanon at medium elevations (below 4,000 ft.) in VI. I doubt whether it ascends as far as *anthe*. Occurs in Iraq and Persia.

Variation. Specimens from the Jerusalem District, possibly because they occur on a limestone formation, sometimes have paler undersides than those taken on sandstone, *e.g.* at Ain Zahalta, South Lebanon. The Palestine ♀♀ are large, often exceeding 34 mm. in length of fore-wing. This species is fond of retiring in the heat of the day to the shelter of overhanging boulders, small caves, etc., whence it may be put up in considerable numbers.

77. **Hyponephele lupinus** Costa, subsp. ?

Costa, Faun. Nap., Pl. IV, figs. 3, 4. "Forests in Terra d'Otranto, Lecce."

Distribution. This species is not recorded by v. Kalchberg or Swinton either from Haifa or the Jerusalem District. Mr. Philby's Transjordanian Coll. contains a large but unfortunately damaged ♀ taken by him at Jerash in N. Transjordania on 19.V.1923. It is an interesting specimen, being very large (f.-w. 25 mm.) and having, as far as its injuries allow inference, considerable fulvous marking on the upperside fore-wing. Races of *H. lupinus* (and *H. lycaon*) occur in Syria.

78. **Epinephele telmessia** Z. subsp. **telmessia.**

Zeller, Isis, 1847, p. 4. "Makri and Marmarice."

Distribution and Dates. A widespread species on the Plateau and in parts of the Coastal Plain, but absent from the Lower Jordan Valley and apparently from Transjordania. First appears before mid-April and persists throughout May into June. Worn ♂♂ can be taken up to the end of the month. At Beirut and Aley, Lebanon, I took worn females in early September 1910. I believe that this was not a case of a 2nd Gen. but of a reappearance of ♀♀ after a temporary aestivation, for the purpose of ovipositing. I have noticed this reappearance after a disappearance during the summer pause of Satyrids at Constantinople, where ♀♀ of *S. circe* and *E. jurtina*, mostly worn females with a few worn ♂♂, reappear in September.

Variation. The underside of the hind-wings is variable in both sexes, the ground-colour varying from a warm drab (Ridgway, Pl. XLVI) through a colder and greyer drab to a pearl grey. The median band is often bordered distally with pale yellow scaling. The Palestine race is identical with that of Beirut, only a little smaller on an average. Neither appear to me to vary sufficiently from the nymotypical race to justify the setting up of a new subspecies. They are perhaps a little more extensively marked—with ochraceous tawny on the fore-wings—than the Anatolian specimens, but the nymotypical race being fairly variable I should not like to affirm that this difference is constant and general. On the other hand, there are grounds for believing the Cyprus race of *telmessia* to be a distinct subspecies.

79. **Agapetes (Melanargia) titea** Kl. subsp. **palaestinensis** Stgr.

Staudinger, Cat., 1901, p. 42. "Lebanon (trans.) and Palestine."

Distribution and Dates. This is one of the commonest butterflies in many parts of the Plateau, *e.g.* around Jerusalem, in May, when hundreds may be seen flying about the rocky boulders and thin scrub of the Judaean Plateau. It occurs in the upper Jordan Valley at 250 ft. below sea-level at Wadi Esh Sheh nr. Beisan, but not apparently in the steppe south of Gaza. The species is found in parts of the Coastal Plain, *e.g.* in the Athlit district. I have only seen one specimen from Transjordania, which was taken by Mr. Philby at Jarash, 20.V. It first appears at lower altitudes in April.

Variation. The typical form described by Klug from "Syria" is certainly not the Palestine race. It is rather larger than the average Palestinian male and much darker, the submarginal area of the upperside of the hind-wings being in particular more broadly marked with black than is usual with Palestine specimens, of which I have a very long series mostly taken by Dr. Buxton before me. But when one comes to inquire what race Klug's figs. represent the answer is not altogether easy. The usual practice has been to restrict the name *titea*, used racially, to the large race from Beirut and the Lebanon Coast, but some of the Lebanon specimens are very like Klug's figs. in Symbolae Physicae, Pl. XXIX, figs. 15–18, and in parts of the Lebanon, *e.g.* about Ain Zahalta, the race is generally darker than *palaestinensis* and is nearer to *titea* than to *titania* of the Anti-Lebanon and Hauran, which is a light "dry" form. The Palestinian insect is seldom as dark as the South Lebanon specimens and seems on the whole to be nearer *titania*. On the coast at Haifa, etc., occur specimens larger than the Lebanon average, in fact as large as many of the Beirut "*titea*," but less heavily marked with black than the latter. Speaking generally there are three main dark races, subdivided into a large coastal race and a smaller mountain race occurring in the Beirut district and parts of the Lebanon, which may be termed a "wet" form of the species, an intermediate race also subdivided into a large coastal race (Haifa), and a race, which is on the whole smaller, from the Palestine Plateau and, *teste* Staudinger, from parts of the Lebanon, and an emphatically "dry"

or desert race from the interior, Hauran, etc. Having only one specimen from Transjordania before me I cannot say what the race of that country is. The specimen looks like *titania* (Calb. Iris, iv, 1891, p. 41), and one would certainly expect to find that race dominant so far inland.

Individual variation is considerable in this rather inconstant species, as among others of the genus. Thus specimens from the same locality differ much in ground-colour, which may vary from yellowish-cream to dead white, in the size and number of the ocellated submarginal spots of the hind-wings, which may be strongly marked or obsolescent, and in the extent of the black markings on both sides of the wings. Aberrative ♀♀ in which the underside of the hind-wing is almost devoid of marking also occur (cf. *Agapetes galatea* f. *leucomelas*).

LIST OF NEW NAMES.

List of new names for subspecies, forms and seasonal forms, whether new or renamed, published in the preceding systematic list.

1. *Hesperia* (*Powellia*) *orbifer* Hb. subsp. *hilaris* Stgr. Seas. form (Gen. II) *hilaris* f. *secunda*, nomen novum.
2. *Thymelicus acteon* Rott. subsp. *phœnix*, subspecies nova.
3. *Plebeius sephyrus* Friv. subsp. *philbyi*, subspecies nova.
4. *Turania* (*Scolitantides*) *baton* Berg. subsp. *nabataeus*, subspecies nova.
5. *Heodes thersamon* f. *militaris*, forma nova.
6. *Aporia crataegi* L. subsp. *augustior*, subspecies nova.
7. *Pieris rapae* L. subsp. *leucosoma* Schaw. Seas. form (Gen. I) *leucosoma* f. *prima* pro "*vaga*" Frühst., nomen novum.
8. *Euchloe belemia* Esp. subsp. *palaestinensis* Röber. Seas. form (Gen. I) *palaestinensis* f. *prima* pro "*belemia*" Esp., nomen novum.
9. *Melitaea phoebe* Knoch. subsp. *dorae*, subspecies nova.
10. *Melitaea trivia* Schiff. subspp. *fascelis*, *trivia* Schiff., *catapelia*, *syriaca* Reb., *persea* Koll. Seas. forms (Gen. II) *fascelis* f. *secunda* pro "*nana*" Stgr., *trivia-secunda*, *catapelia* f. *secunda*, *syriaca* f. *secunda*, *persea* f. *secunda*, nomina nova.

APPENDIX A.

List of Localities.

(Heights are approximate.)

Abu Ghosh . . On Judaean Plateau on Jaffa–Jerusalem Road, alt. 2,000 ft.; also called Qaryet el Enab.

Ain Karim . . . Village to W. of Jerusalem, alt. 2,100 ft.

Ain Malih . . .	Transjordania, about 1 m. from Allenby Bridge in Jordan Valley.
Ain Salaha . . .	Transjordania.
Ain Sara . . . (Ain el Sara)	Transjordania, on E. coast of Dead Sea, 1,292 ft. *below* sea-level.
Ain Sinia . . .	Judaean Plateau between Ramallah and Nablus, alt. 2,600 ft.
Akka (Acre) . .	Coastal Plain, 8 m. N. of Haifa.
Allenby Bridge .	Jordan Valley Bridge crossing Jordan near Jericho, 1,100 ft. *below* sea-level.
Amman	Transjordania, capital of country, on Plateau, alt. nearly 3,000 ft.
Anaiza	Transjordania, station on Hejaz Railway about 20 m. N. of Maan, alt. about 3,400 ft.
Asluj	About 10 m. almost due S. of Beersheba.
Athlit	On coast 12 m. S. of Haifa.
Azraq	Transjordania, marshy oasis in desert 70 m. E. of Amman.
Beersheba . . . (Bir Saba)	In southern foothills of Judaean Plateau, alt. 780 ft.
Beisan	Jordan Valley, 13 m. S. of Lake Tiberias, about 700 ft. *below* sea-level.
Bethany . . .	On Judaean Plateau, 2 m. E. of Jerusalem, alt. 2,400 ft.
Bethel (Beitin) . .	About 9 m. N. of Jerusalem, E. of Jerusalem–Nablus Road.
Bethlehem . . . (Beit Laham)	On Judaean Plateau, 5½ m. S. of Jerusalem, alt. 2,500 ft.
Bethshemem . .	Jewish colony near Ludd.
Bir Ayub . . .	Transjordania, W. of Amman, wherewith it is connected by road.
Bir Salem . . .	In coastal Plain near first foothills of Judaean Plateau, about 1 m. W. of Ramleh, alt. about 250 ft.
Bir Yakub . . .	Arab name of Bir Salem.
Bittir	On Judaean Plateau, on Jaffa–Jerusalem Railway.
Dan	Arabic name Tel-el-Kadi, nr. Banias, at northern border of Palestine below Mt. Hermon at N. end of Plain of Huleh.
Der el Belah . .	In Southern steppe, nr. sea, oasis about 18 m. S. of Gaza.
Engeddi . . . (Ain Jiddi)	Valley on W. shore of Dead Sea, 1,292 ft. *below* sea-level.
Fuheis	Transjordania, village S.S.E. of Salt.
Gaza	In coastal Plain, on Wadi Ghuzzeh, S. of which steppe begins.
Ghor-es-Safi . .	Jordan Valley in Transjordania, port at S.E. extremity of Dead Sea, 1,292 ft. *below* sea-level. Also used of the low plain S. of it.
Haifa	Seaport in Galilee immediately below Mt. Carmel.
Hesban (Heshbon)	Springs and village in Transjordania, S.S.E. of Salt, alt. 2,500–2,800 ft.

Huleh	Jordan Valley, Lake and Plain of that name in Galilee, under 50 ft. *below* sea-level.
Jaffa (Yafa) . .	Principal port in Coastal Plain in Judaea.
Jebel Osha (or Jebel Suwada)	Mountain Range above Salt, Transjordania, height 3,000 to 4,000 ft.
Jebel Sawaiqa . .	Transjordania, N. of R. Zerqa, alt. *circa* 3,500 ft.
Jenin	S. Galilee in Plain to which it gives its name.
Jerash (Jarash) .	N. Transjordania.
Jericho (Eriha) .	Jordan Valley, village 879 ft. *below* sea-level. Slopes above it about 750 ft. *below* sea-level at foot of cliffs.
Jerusalem . . .	Capital of Palestine in Judaean Plateau, alt. 2,400–2,500 ft.
Jisr Banat Yakub .	Bridge over Upper Jordan in Galilee between Lake Tiberias and Lake Huleh.
Jubaiha	Mountainous district, N.W. of Amman, Transjordania, usually given as "Jogbeha" on maps, 3,500–3,800 ft.
Kakun	Coastal Plain, a short distance N.N.W. of Tulkeram.
Kerak (Qaraq) . .	In Moab, Transjordania, alt. 3,200 ft.
Khan Yunus . .	Oasis in steppe 6 m. from Egyptian frontier on railway.
Khedeira . . .	Coastal Plain on railway about 10 m. S. of Athlit.
Kolonia (Quloniya)	Valley 3–4 m. W. of Jerusalem, alt. *circ.* 1,800–1,900 ft.
Ludd	In Coastal Plain about 2 m. N.W. of Ramleh.
Mar Saba . . .	Monastery in defile of Wadi Kelt about 10 m. from Jerusalem.
Merj Sanur . .	Plain on Plateau nr. Samaria.
Mount Carmel . .	Range dividing Galilee from S. Palestine ending above Haifa. Greatest alt. approx. 1,860 ft.
Mount of Olives .	*Arabicé* Jebel Tur. Immediately to E. of Jerusalem, alt. 2,600 ft.
Nablus	Town on Plateau in Cent. Palestine, alt. 2,300 ft., approx.
Nahr Akka . . .	Stream nr. Akka. Coastal Plain.
Nazareth . . .	In W. Galilee, alt. about 1,200 ft.
Nebi Samwil . .	Mountain on Judaean Plateau N.W. of Jerusalem, alt. 2,935 ft.
Nuwaiqis . . .	Nr. Amman, Transjordania.
Petra	In S. Transjordania (Nabataea), 6 hours journey (mule) W. of Maan, alt. 3,000–4,000 ft.
Ramallah . . .	N. of Jerusalem to W. of Nablus Road on Plateau.
Rehoboth . . .	Jewish village, nr. Bir Salem and Ramleh.
Roshpina . . .	Jewish Colony in Galilee nr. Safed, alt. 1,500–2,000 ft.
Rusaifa . . .	In Transjordania.

Salt	In Transjordania on road to Amman, alt. *circa* 2,900 ft.
Samaria (Sebaste)	In Cent. Palestine, alt. *circa* 2,500 ft.
Surafend	In Coastal Plain between Ludd and Jaffa.
Tabagha	Also Ain et Tabagha, on N.W. shore of Sea of Galilee. N. of Tiberias, fishing village.
Tel el Kadi	Modern name for Dan, *q. v.*
Tel el Milh	In extreme S. of Judaean Plateau 15–16 m. E. of Beersheba.
Tel Khuweilfa	Nr. Khan el Khuweilfa, 11 m. N.W. of Beersheba.
Tiberias	On W. shore of Lake of the same name, which is 682 ft. *below* sea-level.
Tulkeram	On Ludd-Haifa Railway in Northern Plain of Sharon nr. foothills.
Umm el Kilab	In Southern steppe about 3 m. from Rafa and Egyptian frontier.
Wadi Biar	On Plateau W. of Jerusalem.
Wadi el Hawaris	On Plateau N.W. of Samaria.
Wadi Fara	Long and deep gorge with perennial stream leading E.S.E., flowing into Jordan Valley from Nablus Mountains. About 800 ft. *below* sea-level at mouth of gorge.
Wadi Kabala	On Judaean Plateau about 10 m. W. of Jerusalem.
Wadi Kelt	Stream flowing through gorges from E. slope of Judaean Plateau into Jordan Valley nr. Jericho.
Wadi Rubin	In Southern Plain of Sharon.
Wadi Sir	Transjordania, valley to S. and S.E. of Salt.
Wadi Zarqa Main	Transjordania, stream entering Dead Sea through deep gorges.
Wilderness of Judaea	Name applied to the desolate Eastern and Southern slopes of the Judaean Plateau. The Southern slopes are also known as the "Negeb."
Wilhelma	German village to E. of Jaffa.
Zarqa	River in Transjordania. The name is applied in reference to Mr. Philby's specimens to the country near the Zarqa Railway station, 9–10 m. N. of Amman. Not to be confused with Wadi Zarqa Main.

APPENDIX B.

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Fountaine. Miss M. Fountaine collected in Palestine on her way to Jerusalem from Syria in 1901. References are to be found in her paper, "A few Notes on some of the Butterflies of Syria and Palestine," published in the Entomologist, vol. xxxv, pp. 60–63, 97–101.

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Herzog. Mein Schmetterlingfang in Aegypten und Syrien, Jahr-Ber. Ent. Ver. Wien., xxi (1910–1911), pp. 85–91, and corrections in the same Journal, xxii (1911–1912), p. 1. A slight account of a collecting trip in Egypt and Palestine.

v. Kalchberg (Kalchbg.). See Iris, vol. x, pp. 161–190, 1897, for a list of the Lepidoptera of Haifa compiled by Freiherr A. von Kalchberg of Vienna. A very useful list of the Lepidoptera of Haifa and Mt. Carmel to which Dr. O. Staudinger contributed. Freiherr von Kalchberg also described and figured *A. cardamines phoenissa* q. v. for reference.

Kneucker (Rebel and Daub). Zoologische Ergebnisse zweier . . . in Sinai Halbinsel unternommener botanischer Studienreisen, Verh. natw. Verein, Karlsruhe, No. 21 (1907–1908), and Supplement (1909), pp. 129–146. The Lepidoptera taken in the course of two journeys to the Sinai, the second of which was followed by a visit to Palestine and Syria, are described in a valuable paper by Professor Rebel and Herr M. Daub.

Staudinger (Stgr.). Among the numerous species of Lepidoptera from Palestine described in Iris by Dr. O. Staudinger are *Iolaus jordanus* and *Teracolus phisadia palaestinensis*. The references will be found under the species in question.

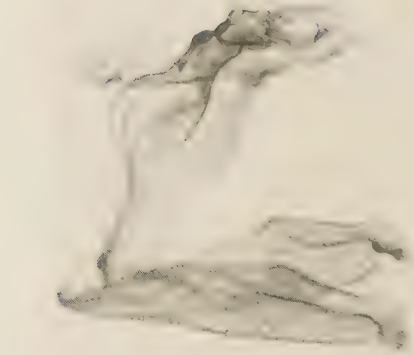
Swinton. See Ent. Monthly Magazine, pp. 181–184, 1898. Mr. Swinton therein published a list of Lepidoptera taken in the vicinity of Jerusalem from April to September 1896.

Collections.

B.M. British Museum Collection. This contains a good deal of material from Palestine, and Mr. Philby's collection from the Transjordan has recently been added to it. Among the Palestine specimens are a number collected by Mr. Pratt in Galilee in 1886.

Buxton (P.A.B.). A large collection made almost exclusively in Palestine by Dr. Buxton accompanied by full data inspired the writer to undertake this paper.

Hope Museum. In the Hope Museum are two collections from Palestine, that made by Mr. Bell in the Gaza District in III.–V.1918 and Capt. Barraud's specimens, which formed part of the collection of the late Mr. H. Rowland-Brown, F.E.S., which was bequeathed by him to the Museum. There are



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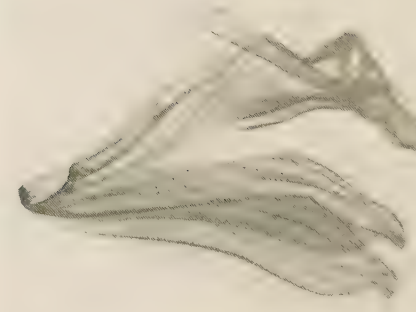

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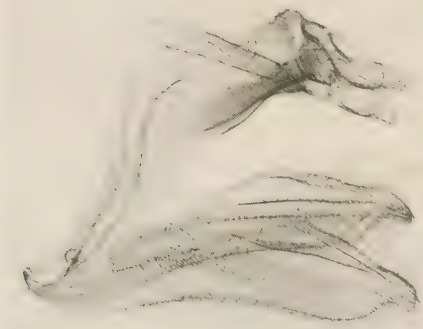

3

A. H. Dennis, Phot. *Vaus & Crampton, Ltd.*

♂ Genitalia of Polyommatus icarus, Rott. and of ♀ P. lucetta (lucia), Culot.

O. F. Tassart, del.

Vaus & Crampton, Ltd.

BUTTERFLIES FROM PALESTINE
AND TRANSJORDANIA.

also some specimens collected by Canon Tristram, but of these some, e.g., *Polyommatus amandus*, are undoubtedly from the South Lebanon, which the Canon includes with Palestine in his "Fauna and Flora of Palestine."

Hemming. Capt. A. F. Hemming's interesting collection from many parts of Palestine, made by Major Lockhart in 1922–1923, and the writer's own collection have also served in providing data for this paper.

Mus. Min. Agr. The Museum of the Ministry of Agriculture, Cairo, contains several small collections made by the late Mr. G. Storey, the writer, and others during the campaign of 1917–1918 and subsequently.

Description of Lycaenid genitalia figured on Plate IV.

No. 1 (255). *Polyommatus*? *lucetta* (*lucia*) Culot. Nazareth. 30.VI.1921, taken by P. A. Buxton. Now in B.M.

2 (270). *Polyommatus icarus*. Yozgad, Asia-Minor, 5,000 ft., June–Sept. 1918. Now in B.M.

3 (271). *Polyommatus icarus*, sent by M. Culot as *lucetta*. Beirut Syria. Now in B.M.

Numbers in brackets are those of the preparations of the genitalia in the B.M.

Explanation of Plate V.

No. 1. *Plebeius sephyrus philbyi*, ♂, Petra, 28.III.1923.

2. „ „ „ ♀, „ „ „

3. *Thymelicus lineola major-clara*, ♂, 10 miles E. of Jerusalem, 17.IV.1922.

4. „ *flava syriaca*, ♂, 10 miles E. of Jerusalem, 17.IV.1922.

5. *Turania baton nabataeus*, ♂, Petra, 16.III.1923.

6. *Thymelicus acteon phoenix*, ♂, Jemhur-Areya, Lebanon, 1,000–1,500 ft., 14.V.1905.

7. „ „ „ ♀, Beirut, b.VI.1911.

8. *Pieris rapae leucosoma*, ♀, Beirut, IV.1911.

9. „ „ *leucosoma* f. *prima*, ♀, Jericho, 17–18.III.1922 (co-type).

10. *Aporia crataegi augustior*, ♂, Salt, 18.IV.1923.

V. *The Morphology of the Male Genitalia in* Rhynchota.

By Hem Singh-Pruthi, Ph.D., Charles Abercrombie Smith Research Student, Peterhouse, Cambridge.

[*From the Zoological Laboratory, University of Cambridge.*]

[Read October 15th, 1924.]

Plates VI–XXXII and 3 Text-Figures.

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I. INTRODUCTION.

The study of genitalia is destined to play an important rôle in the taxonomy of insects. Numerous workers upon almost all the different orders have conclusively shown the value of these organs in affording reliable generic and specific characters. As a consequence of the researches of Walker (59), Sharp and Muir (53), Bethune-Baker (3), Buchanan-White (4), Edwards (18), Christophers (12), etc., in some of the main orders, *e.g.* Orthoptera, Coleoptera, Lepidoptera and Diptera, the morphology of the genitalia is now almost clear, so that it has become a sort of routine with the specialists to use them in separating genera and species.

In Rhynchota practically no attempt has so far been made

to settle the morphology of the above organs. The works of several authorities, Fieber (20), Muir (39), Hungerford (28), Lawson (35), Gifford (21), Buckton (5), etc., while proving the first-rate importance of the genitalia in classification, show that in the absence of a detailed morphological account there has been a great multiplicity of terms and a considerable amount of confusion in their application. Every worker has proposed his own terminology or used the terms of others for organs different from those for which they were originally invented. To quote one instance out of numbers, Buckton takes the term " cauda " from Sharp's work on Pentatomidae (52), where it is used for the terminal abdominal segment round the anus (Xth), and uses it in Homoptera for a process below the anus, a process which does not even occur in the Pentatomidae. Again in his description and figures, he has repeatedly confused this " cauda " with " penis," two organs entirely distinct. Though systematists regard the male genitalia as affording the final test of a species, and often even as being of generic importance, they are seldom interested in the homologies of these structures, and frequently the result is that the same organ is given two different names in even closely allied families.

In Section V, I have referred to the few anatomical works that exist.

An attempt has been made in the present investigation to describe the morphology of these organs in both Heteroptera and Homoptera. The terminal abdominal segments themselves show interesting modifications in relation to the genitalia, but, as their detailed study is beyond the scope of this work, reference to them is made only where their modifications are very conspicuous.

So far as the taxonomic value of this memoir is concerned, it is not meant to be more than a sort of morphological work of reference for specialists desirous of studying exhaustively any Rhynchotous family on the basis of genitalia. However, brief comments on the position of several genera and sub-families have been made along with the account of the genitalia, and a short discussion with regard to the inter-relationships of the sub-families and families is appended at the end of the anatomical account of each family. Moreover, at the end of each section, Heteroptera (pp. 186–187) and Homoptera (pp. 236–237), the different systems of classification are discussed in the

light of the present work. But, of course, I do not mean to convey that classification should be or can be based on any one set of organs alone.

Owing to the paucity of material, there are many gaps in the work, and at several places forms could not be chosen for description as one desired, but an attempt has been made to examine representatives of every family and even of each sub-family in order to get an idea of the range of modifications and to determine the number of morphological types. It is needless to add that many more forms were examined than are actually described here, but the remarks made are based on all the forms studied.

In order to bring the genitalia in Rhynchota into line with those in other orders of insects, the development of these organs has also been studied; the detailed results will be given later in a separate communication.*

To understand and appreciate the function of these organs, the terminal abdominal segments and the genitalia in the female have also been examined and briefly described. The female armature presents interesting morphological features of its own, but an account of it must be reserved for a future publication.

A considerable amount of difficulty was experienced in settling the order in which the different families were to be arranged, no two existing systems agreeing in all details in this respect. Usually Oshanin's recent arrangement (45), based on the systems of Reuter, Horváth and Kirkaldy, has been followed, but in several places divergence has been made from this; so an index has been appended at the end (*p.* 250), embodying the list of the sub-families examined, the arrangement actually followed, and references to the pages on which an account of them occurs and to the figures illustrating them.

The most important essential in a work of the present kind is the correctness of the names of the specimens described. My material has all been either named or verified either by Mr. W. E. China of the British Museum of Natural History, London, or by Mr. E. A. Butler, B.Sc., F.E.S., of London, or by Mr. F. Muir, F.E.S., of Honolulu.

* These results have been published in *Q.J.M.S.*, Vol. 69, Part I, December, 1924, pp. 59–96.

II. TECHNIQUE AND METHODS.

According to the size, the terminal abdominal segments, the abdomen or the whole body of the insect were placed in 10 per cent. solution of KOH and allowed to remain there for a period varying from twenty hours to several days, until the organs were soft and transparent. If the specimen was not a freshly killed one, it was first soaked in warm water to ensure an even penetration of potash. The common practice of boiling in the alkali was avoided unless a certain feature had to be re-examined only for confirmation, etc. After the treatment with potash, the material was run through the alcohols for dehydration in the usual way, a few drops of acetic acid being added to the 50 per cent. spirit in order to remove the remains of the potash. Delicate and transparent organs were stained with picro-carmine, or a small amount of picric acid was put in the clove oil used as the clearing reagent.

To prepare the material for sectioning, chitin was softened in diaphanol. Unlike the majority of reagents usually suggested for this purpose, diaphanol did not injure the soft parts, if the specimen, such as the abdomen of *Pyrrhocoris apterus*, was not kept in it for more than three or four days. The specimen, before it is put in this reagent, must be sufficiently hard (allow it to remain for a week in 90 per cent. alcohol). Freshly prepared fixatives of Carnoy or Gilson were found very satisfactory. Smaller individuals were doubly embedded in celloidin (clove oil) and paraffin.

All the figures have been made with a camera lucida. The most superficial organs have been represented by solid lines, those within by broken ones, the ducts being represented by dots. Thick lines represent thicker chitin, thin lines thinner chitin. The boldness or lightness of the lines represents nearness or remoteness respectively of the organs to or from the observer's eye. Most of the figures represent the parts as seen from the left side in the case of Heteroptera and from the right in Homoptera. To bring out certain features more clearly, this principle had to be abandoned in certain cases.

III. ACKNOWLEDGMENTS.

It is with great pleasure that I take this opportunity of expressing my feelings of gratitude to my several benefactors and friends who have assisted me in connection with the present work.

The investigation was begun in the Entomological Laboratory of the Agricultural College, Lyallpur, Punjab, India, where Professor M. A. Husain showed great interest in my work. In an Agricultural Department, morphological problems of this kind are not much encouraged, and it was due to the interest in pure scientific work shown by Mr. Husain that it was possible to start the present research.

The work was continued and completed in the Zoological Laboratory of the University of Cambridge. There Mr. F. Balfour-Browne, M.A., the supervisor of my research, very keenly and sympathetically watched the progress of the work and made valuable suggestions and criticisms with regard to it.

Of no less help to me were Dr. Hugh Scott and Mr. E. A. Butler, F.E.S., who kindly and ungrudgingly supplied me with very valuable material. Messrs. F. Muir (Honolulu), W. E. China (British Natural History Museum), and Professor Heymons (Berlin), assisted me very much by giving valuable information. Mr. Muir also sent me some very interesting Homopterous forms. Messrs. Butler and China and Dr. Hugh Scott went through the manuscript and made several suggestions, especially with regard to the Systematic part. My indebtedness to Mr. China in the matter of determining specimens has been mentioned in a previous section.

My sincere thanks are also due to the trustees of S. Balwant Singh Fund for Scientific Education, who gave me a grant while I was engaged on this research.

IV. INTRODUCTORY ACCOUNT AND TERMINOLOGY.

(Pl. VI, figs. 1, 2 and 3.)

The abdomen consists of ten almost complete segments, and in Homoptera there are several sclerites besides, which might be the remains of the eleventh.

Ist–VIIth do not need any comment.

VIIIth-Xth are associated with the reproductive activities. They often remain retracted within the VIIth and do not show distinct terga or sterna. In most Heteroptera the VIIIth is small, membranised in its dorsal region, and closely covering the base of the IXth. In some Homoptera its sternal region is much prolonged posteriorly, below the genitalia, thus forming a distinct *hypandrium* (hp). Crampton applied this term to the similarly modified VIIIth or IXth sternite without distinction.

The IXth bears the genitalia and is much modified. It is very large and its sternal region, small in Homoptera (fig. 3), is very much enlarged in Heteroptera (figs. 1 and 2). However, its lateral regions are specially well developed in the former sub-order, where they are often called *pygofers*. Some workers call the whole of the IXth segment, the " pygofer "; but I will use the term in the former sense only.

The Xth is very small, ring-like, has its sternal region at a higher level than that of the IXth, hence the intersegmental membrane, joining the two, referred to for the sake of brevity as the *segmental membrane* (sm), is very large. The copulatory organ originates from the segmental membrane, which, especially in Heteroptera, forms a pouch in which the organ lies. This pouch will be referred to as the *genital chamber* (gc). Sometimes a process, usually with a rounded apex, with its upper surface scooped out, is present on the floor of the genital chamber near its opening—this is the *inferior* process (inf) of Sharp.

In almost all Homoptera, the IXth sternite, which as above mentioned is much smaller than that in Heteroptera, bears a pair of well-developed appendages at its posterior margin –the " genital plates of some authors," which will be called *sub-genital plates* (gp), because " genital plates," " genital styles," etc., are names usually given to the pair of appendages lying one on each side of the aedeagus—that is, to the parameres (see below).

The genitalia consist essentially of a median tubular organ, the *aedeagus* (aed), which, as already mentioned, is a backward continuation of the body wall between the IXth and Xth sternites—that is, of the segmental membrane. The ejaculatory duct bringing spermatozoa from the testes enters this organ, and opens at its apex by the *gonopore* (gnp). Theoretically, both the aedeagus and the

ejaculatory duct constitute the single genital tube, which, as pointed out by Sharp and Muir in the case of Coleoptera, is a doubled tube, arising from the invagination of the tube into itself, one end of which is a continuation of the body wall, while the other forks into two, the vasa deferentia, which are connected to the testes.

The opening by which the aedeagus is in communication with the body cavity and through which the ejaculatory duct enters it, will be referred to as the *basal foramen* (bf).

A pair of appendages lie one on either side of the aedeagus, and are directly or indirectly connected to its base. These appendages have so far been given different names in the two sub-orders, "laterals" or "claspers" in Heteroptera and "genital styles," etc. in Homoptera. It will be clearly proved hereafter that these so-called "laterals" and "genital styles" are homologous in the two sub-orders and so ought to be named uniformly; moreover, the word "style" is misleading, the appendages often termed so and present in some Thysanura, Myriopoda, etc., being not considered as true appendages; so the above appendages will be called the *parameres* (pr) (Verhoeff).

The aedeagus is a long tube, often unequally chitinised; this differential chitinisation is well marked in Heteroptera, where in the condition of repose the distal region of the aedeagus is retracted into the proximal, the latter therefore is the only part of the aedeagus ordinarily apparent and hence will be termed the *phallosoma* (phs). The distal region, which is invaginable into the phallosoma, will be called the *endosoma* (ends). The endosoma again is generally differentiated into two regions, (i) the proximal: wide and membranous, here called the *conjunctiva* (cnj), which in the condition of retraction comes to line the inside of the phallosoma (its distal regions coming nearer the base of the aedeagus), and (ii) the distal: narrow and stiff, which lies in the centre and is often the proper intromittent organ—this will be called the *vesica* (vs). The junction of the conjunctiva and vesica, in some Heteroptera, is fused to the ejaculatory duct within, which is often thickened and expanded in that region; the expansion will be termed the *ejaculatory reservoir* (ejr). Beyond the "reservoir" the ejaculatory duct again narrows, but remains still thick-walled and runs through the vesica to open at the gonopore. The aedeagus therefore is differentiated into three regions, which, when the individual is not copulating, remain tele-

scoped into one another, the distal portions of the conjunctiva appearing proximal. In the descriptions the words "proximal" and "distal" will be used as if the aedeagus is fully everted and all its regions are exposed.

The region of junction of phallosoma and endosoma, where the latter is invaginated into the former, has the appearance of a big foramen through which the endosoma (conjunctiva and vesica) can be evaginated. This will be termed the *phallosoma mouth* (phs. mth), to distinguish it from the genital pore or the gonopore which is at the distal end of the vesica.

Sharp failed to recognise the continuity between the above described phallosoma and endosoma regions of the aedeagus. He imagined only the distal region of the latter (vesica) to be the sole aedeagus, and considered the phallosoma (his "theca") as an additional coat round the "aedeagus."

It may be remarked that the above three regions, phallosoma, conjunctiva and vesica, are often imperceptibly continuous into one another. Moreover, as all the three *together* constitute the single aedeagus, so one is as important as the other, though one may be highly chitinised and the others greatly membranised. Furthermore, sometimes the endosoma is membranous throughout and undifferentiated into conjunctiva and vesica. Then, in most Homoptera the whole of the aedeagus is uniformly hard and permanently exposed, there being no distal invaginable region (endosomic), the ejaculatory duct running straight through and opening at the apex.

The aedeagus often bears a number of hollow or solidified diverticula in its different regions, these will be designated as the *phallosoma*, *conjunctiva*, or *vesica appendages* respectively, according to the region bearing them. These appendages, which often point towards the caudal end, when the aedeagus is at rest, are directed towards its base when the different regions are fully everted, and thus they give a hold to the aedeagus within the female parts during copulation. These primary appendages sometimes bear secondary processes, spines, hooks, etc.

In all the Heteroptera the basal foramen on either side is strengthened by a heavily chitinised curved plate. These two plates meet in the mid-ventral line and thus form a horseshoe-shaped structure in T.S. Nobody has so far shown that these plates are of regular occurrence in the

order, and Christophers (11) probably meant these plates when he said that in *Cimex* the aedeagus base has a "curious stirrup-shaped" piece. They will be termed the *basal plates* (bp). The ejaculatory duct, as it enters the aedeagus, passes over their place of junction, often under a small chitinous archway, which will be called the *basal plates bridge* (bp. br). To the basal plates are attached powerful muscles which are concerned in the movements of the aedeagus as a whole. Moreover, from the place where they meet in the median ventral line, begin chitinous ligaments and muscles which at the other end are attached to the base of the vesica, and are thus concerned in the evagination or retraction of this organ. The free ends of the plates (dorsal in position) are always in association with the bases of the parameres.

The basal plates are present in all the Homoptera as well, but have undergone extraordinary modifications. In consequence of the shifting backwards (caudad) of the basal foramen (*i.e.* the part of the aedeagus corresponding to the basal region of the organ in Heteroptera has amalgamated with the body cavity) the basal plates are no longer in the basal rims bordering the basal foramen, but lie on the inner face (facing the body cavity) of the segmental membrane. Their point of meeting each other is still in contact with the median ventral region of the base of the aedeagus. Moreover, their free ends have not lost contact with the bases of the parameres.

In the different families of Homoptera the tendency is for the aedeagus to originate from a higher and higher level, nearer the base of the Xth segment. The basal plates, in order that they may remain in contact with its base are either prolonged themselves or their point of junction with each other is elongated into a rod-like organ, which will be called *basal plates prolongation* (bp. pr). Thus the plates assume the form of V, Y, or T in the different families.

This V- or Y-shaped structure at the base of the aedeagus has confused many homopterists; the majority of them have ignored it altogether, while some, *e.g.* Lawson (35), etc., refer to it as a "curious structure for which there is no homologue in literature," and call it "aedeagus style connective" because of its association with both of these parts. Some (Muir, etc.) have simply passed it over without comment, merely calling it an "apodeme."

So far as the available literature shows, nobody has even suspected that the "stirrup"-shaped organ in Heteroptera is the same as the curious V- or Y-shaped structure in Homoptera.

List of the Terms and their Lettering.

Aedeagus (aed) is the tube through which the ejaculatory duct bringing sperms from the testes runs and ends at its apex.

Aedeagus basal support (aed. b. st) is the heavier chitinisation of the segmental membrane between the place of origin of the aedeagus and the base of the anal segment. Present in some Homoptera.

Anal style (as) is an elongated spoon-shaped process under the anus. Common in Homoptera.

Basal foramen (bf) is the aperture from which the aedeagus projects from the body cavity.

Basal plates (bp). In Heteroptera a pair of heavilychitinised curved plates on either side of the basal foramen. In Homoptera they form a V- or Y-shaped structure at the base of the aedeagus, and lie on the inside of the segmental membrane, facing the body cavity.

Basal plates prolongation (bp. pr) is the rod-like prolongation of the point of fusion with each other of the basal plates. Common in Homoptera.

Basal plates bridge (bp. br) is a small archway at the point of fusion of the basal plates, under which the ejaculatory duct enters the aedeagus.

Conjunctiva (cnj) is the middle membranous region of the aedeagus or the proximal region of the endosoma which lines the basal region of the aedeagus (phallosoma) in the condition of repose.

Conjunctiva appendages (cnj. app) are the several appendages borne by the conjunctiva.

Ejaculatory duct (ejd) is the common duct formed by the two vasa deferentia. It runs through the whole length of the aedeagus and ends at its apex, the gonopore.

Ejaculatory reservoir (ejr) is an expansion of the ejaculatory duct at the base of the vesica. Present in Heteroptera.

Endosoma (ends) is the distal region of the aedeagus which remains telescoped within the proximal (phallosoma) in the state of repose.

Genital chamber (gc) is a pouch produced by the invagination or pushing in cephalad of the body wall between the IXth and Xth sternites.

Gonopore (gnp) is the place where the ejaculatory duct ends at the apex of the aedeagus.

Hypandrium (hyp) is the posteriorly produced sternal region of the VIIIth abdominal segment. Common in Cicadidae.

Inferior process (inf) is the conical depressed process on the floor of the genital chamber, near its opening.

Parameres (pr) are the pair of appendages lying one on either side of the aedeagus and in association with the free ends of the basal plates.

Periandrium (peri) is the bulb-like growth of the segmental membrane round the base of the aedeagus. Common in Cercopidae.

Phallosoma (phs) is the proximal region of the aedeagus which is the only part exposed when the insect is not copulating.

Pygofers (pgr) are the large and conspicuous lateral regions of the IXth abdominal segment in Homoptera.

Segmental membrane (sm) is the vast intersegmental membrane between the IXth and Xth abdominal segments.

Sub-genital plates (gp) are the pair of plates at the posterior margin of the IXth sternite. Present in most Homoptera.

Vesica (vs) is the distal stiff region of the aedeagus.

Vesica appendages (vs. app) are the appendages borne by the vesica.

The Roman numerals I, II, III, IV . . . X, XI, etc., refer to the respective abdominal segments; the letters t, p, s, affixed to these imply the tergal, pleural or sternal region respectively of the particular segment.

Besides the above there are several terms which are of occasional use; their explanation and lettering are given in the text in the particular sections in which they have been used.

V. HISTORICAL.

Dufour (16 and 17) gave a crude anatomy of the genitalia in several bugs. He described chiefly the IXth abdominal segment, his "armure copulateur," and references to "Verge" (aedeagus) and "Crochet" (parameres), if made at all, are only made to their

in the female; but these appendages in the male are absent in the adult condition in most insects except in some Apterygota (Wheeler (61), Walker (56 and 59), etc.). Therefore, obviously, Newell has been led astray in finding these appendages in Rhynchota and other higher insects.

Berlese (2) was the first investigator to go into more details. He described the genitalia of *Rhaphigaster*, *Pentatoma*, *Naucoris*, *Notonecta*, *Nepa* and *Cicada*. In the first five (Heteropterous forms) he seems to believe, unlike the investigators who preceded or have since followed him, that the aedeagus, his "verga," originates from between the tergite and sternite of the Xth abdominal segment. Moreover, the parts that he calls the Xth tergite and sternite are not the same in all the forms, they are actually parameres and IXth sternite respectively in *Raphigaster* and *Pentatoma*. IXth tergite plus Xth segment and IXth sternite in *Notonecta* and *Naucoris*, IXth tergite plus Xth segment and phallosoma in *Nepa* and *Ranatra*. If he had shifted one segment in every form it would have been a different matter, but to label the same and moreover similar organs in *Notonecta* and *Nepa* as Xth and IXth sternite respectively is not justifiable. Moreover, it is clear from the above that in most cases, as he is interpreting portions of the IXth as of the Xth, naturally he is describing portions of the VIIIth as belonging to the IXth, in spite of the fact that they have a pair of spiracles, *e.g.* the respiratory siphons in *Nepa*, which are, as is well known, the enlarged dorso-lateral regions (pleurites) of the VIIIth segment, are labelled by him as IXth tergite (his Fig. 386), etc.

In *Cicada*, however, he correctly shows the aedeagus originating from between the IXth and Xth sternites.

Berlese, unlike most of the before-mentioned investigators, did not ignore the basal plates, he faithfully figures them in *Pentatoma*, *Nepa* and *Cicada*, but he does not interpret them to be the same organ. In *Pentatoma* and in *Cicada* he terms them "epifallo" and "ipofallo" respectively, thus comparing them to the basal region of the aedeagus and parameres respectively in forms like *Oryctes* and *Hydrophilus* (his Figs. 378 and 381). In *Nepa* he calls them "processi chitinei di raccordo col IXth sternite" (Fig. 385).

Christophers and Cragg (11) in 1922 have given a good description of the genitalia in the Bed Bug, *Cimex lectularius*. They correctly state that the distal region of the aedeagus is invaginable into the proximal, and that one of the parameres (their "laterals") is reduced to extinction. They refer to the basal plates or "basal fold" as a "circumphallic chitinisation encircling the base of the phallosoma and usually forming a bed for its reception . . . from

this the whole organ is slung," a description quite good in view of the fact that they were not supposed to be acquainted with the structure of these organs in the order as a whole.

The chief point of interest in the works of Kershaw (29) and Kershaw and Muir (30) is the fate of the sub-genital plates, their "g^1." In 1918, when Kershaw wrote alone, he stated that "g^1" along with other appendages (g^2 and g^3—aedeagus and parameres) arose from one median evagination in connection with the IXth abdominal segment. In their joint recent paper they said that "g^1" belongs to the VIIIth abdominal segment and only subsequently gets attached to the IXth. It seems very difficult to agree with them in this view. It will be seen hereafter that the sub-genital plates, "g^1," are present only in forms having a very small IXth sternite and are most probably the posterior portion of the sternite; moreover, in some families, e.g. *Membracidae*, they are absolutely continuous with and of the same consistency as the IXth sternite, the segmental membrane reaching their apices. They are absent in all Heteroptera, *Cicadidae*, Fulgoroideae, *Coccids* and *Psyllids*, where the IXth sternite itself is very large.

Moreover, the development of these appendages definitely points out that they have no connection with the VIIIth segment at any stage in the ontogeny.

Kershaw and Muir at the end of their short paper made a general statement dealing with the anatomy of the genitalia in the whole super-family Fulgoroideae. I differ from them in several respects; their statement will be fully discussed when dealing with this particular group.

References to the superficial features of genitalia in Jassidae have been made by several systematists, *e.g.* Buckton, Edwards (19), Signoret (54), but Lawson (35) has treated the subject in more detail. He, for the first time, noticed the existence of the basal plates, his "aedeagus style connective," as a structure of constant occurrence in the family. He could not say what it was, and left it with the remark: "The question of its homologies seems to afford an interesting problem for future work." Lawson did not grasp the true morphological relations of the genitalia as a whole. For instance, he makes the sweeping statement that parameres, his "genital styles," are fastened to the dorsal surface of the sub-genital plates. This feature, as will be seen later on, is present only in a few specialised forms. On the whole, his descriptions are anatomically correct in giving dimensions of various spines and processes, but are almost vague from a morphological point of view. He has left his diagrams unlabelled, which considerably decreases the value of his work.

Very recently Poisson (47) has given an account of the genitalia in several aquatic Rhynchota. He has, however, restricted himself to finding out characters for separating species and genera, and has paid very little attention to the morphology of these organs, as is evident from some of his conclusions summarised below :—

1. The Copulatory organ in Gerridae is in connection with the VIIIth segment (his page 171–172, Fig. 1), while in *Naucoridae*, *Corixidae*, etc. it is connected with the IXth.

2. The Genital segment is the last abdominal segment, and the anus is carried by a portion of it. It may be remarked that the genitalia are believed to be borne by the penultimate (IXth) segment, while the anus is at the end of the last (Xth).

3. Parameres in Gerridae are not homologous to those in other families. While in all other families he labels them as "*styli*," in Gerridae he calls them "*organe titillateur*."

VI. SPECIAL MORPHOLOGY.

(*a*) *HETEROPTERA.*

Series I. POLYNEURIA.

Super-fam. *Pentatomoideae.*

Phal. *Plataspidiformes.*

Family PLATASPIDAE.

Forms examined : *Coptosoma cribrarium* F., *Brachyplatys pusillus* Tryon, etc.

Coptosoma cribrarium. (Pl. VII, fig. 4.)

Aedeagus differentiated into well-defined phallosoma, conjunctiva and vesica.

Basal plates short, curved, forming an almost complete ring. Phallosoma large, and wider in the proximal region. Conjunctiva thickened in four longitudinal patches, arranged in two pairs, beginning from its distal dorso-lateral and ventro-lateral regions, corresponding to appendages No. 2 and 3 of other Pentatomoideae. In addition there is a very small third pair in the proximal dorsal region (cnj. app[1]). Vesica very much flattened, wide in the proximal region, considerably narrowed and tapering distally, fused throughout with the ejaculatory duct within, the latter being very wide and heavily chitinised, and thus providing stiffness to the vesica.

Ejaculatory duct expanded into a bean-shaped ejaculatory reservoir at the base of the vesica. Parameres elongated, and hook-like in the distal region.

Brachyplatys pusillus. (Pl. VII, fig. 5.)

Conjunctiva with only one pair of well-developed appendages, corresponding to No. 3. Vesica cylindrical, long and narrow. Ejaculatory reservoir smaller and elongated. Parameres flattened in the proximal region, considerably narrowed in the distal and pointed at the apices.

Remarks.—Genitalia in Plataspidae are of the same type as common in Pentatomidae (vide infra), coming somewhere between those in Pentatominae and Scutellerinae. Hence the Plataspidae do not seem to deserve the rank of a separate family.

Phal. *Pentatomiformes.*

Family Cydnidae.

Forms examined : *Geotomus* sp. (near *punctulatus* Costa), *Sehirus* sp. (probably *morio* L.), *Cyrtomenus mirabilis* Perty., etc.

Geotomus sp. (Pl. VII, fig. 6.)

Basal plates themselves small, but produced into long chitinous struts in the dorsal direction. Phallosoma long and cylindrical. Conjunctiva bears two pairs of appendages, No. 2 and 3, as in Plataspidae; the appendages indistinct, being fused to the conjunctiva surface, except at the apices. Vesica narrow, stiff, whip-like; its wall hardly separable from the ejaculatory duct within. The ejaculatory reservoir elongated and coiled. Parameres short, flattened and leaf-like.

Sehirus sp. (Pl. VII, fig. 7.)

The conjunctiva appendages appear as more distinct appendages. Vesica shorter. Ejaculatory reservoir small. Parameres longer.

Remarks.—Genitalia in Cydnidae as in Plataspidae are essentially of the type common in the different sub-families of Pentatomidae. Most Rhynchotists have treated Cydnidae as a sub-family of Pentatomidae, an arrangement supported by the structure of the genitalia.

Family Pentatomidae.

Sub-family *Asopinae*.

Forms examined: *Picromerus bidens* L., *Stiretrus anchorago* F., *Platynopus rostratus* Dru., etc.

Picromerus bidens. (Pl. VII, fig. 8.)

Basal plates short and thick. Phallosoma short, slightly wider in the distal region. Conjunctiva comparatively much wider, larger, permanently exposed and produced laterally into two flaps which point caudad; its extreme distal region membranous, bearing a pair of long appendages, corresponding to No. 2; appendages hardly free of the conjunctiva surface. Vesica enclosed by the conjunctiva flaps, short, narrow, stiff, fused to the ejaculatory duct within. Ejaculatory reservoir very well developed. Parameres leaf-like.

Stiretrus anchorago. (Pl. VII, fig. 9.)

Almost similar to *Picromerus*. Parameres, however, short, flattened and curved.

Remarks.—Genitalia in Asopinae are of the Pentatomine type (vide infra).

Sub-family *Scutellerinae*.

Forms examined: *Cantao ocellatus* Thunb., *Scutellera nobilis* F., *Philia* (= *Lampromicra*) *senator* F., *Chrysocoris stockerus* L., etc.

Cantao ocellatus. (Pl. VII, fig. 10.)

Basal plates very stout and prolonged dorsally. Phallosoma funnel-shaped and very tough. Conjunctiva produced into three pairs of appendages, No. 1, 2 and 3; the first two have a common base, the second and the third heavily chitinised and more distinct as appendages, the first membranous. Vesica very long, stout, extremely hard; its apex trilobed, the dorsal lobe pointed and having the gonopore at the apex. Ejaculatory reservoir also thick-walled and large. Ejaculatory duct wide and thick, completely fused to the vesica, leaving only a small lumen in the centre for the passage of the spermatozoa. Parameres long, hook-like in the distal region.

Philia (= Lampromicra) senator. (Pl. VII, fig. 11.)

Phallosoma wider and shorter, vesica bent at several places. Parameres stouter.

Scutellera nobilis. (Pl. VII, fig. 12.)

Genitalia are almost similar to those in *Philia*. Conjunctiva appendages more flattened and vesica points slightly downwards.

Remarks.—It seems probable that the above two forms do not deserve to be put in two different genera.

Chrysocoris stockerus. (Pl. VII, fig. 13.)

Comes nearer to *Cantao ocellatus*, differing only in the greater development of the conjunctiva appendages and the form of the parameres, which are deeply curved in the distal region.

Remarks.—In the presence of three pairs of conjunctiva appendages, the nature of the vesica, the elongated shape of the reservoir, etc., the genitalia in the Scutellerinae are of the same plan as those in Plataspidae and (p. 142) Cydnidae (p. 143), but more specialised.

Sub-family *Graphosominae*.

Graphosoma lineatum L. (Pl. VII, fig. 14.)

Similar to Asopinae, except that the conjunctiva is smaller and parameres are of different shape.

Podops inuncta F. (Pl. VII, fig. 15.)

Conjunctiva for greater part of its length permanently exposed, parameres slender, otherwise similar to *Graphosoma*.

Remarks.—The genitalia in this sub-family are distinctly of the Pentatomine type (vide infra). Distant (13) placed this sub-family between Scutellerinae and Cydninae, which seems therefore hardly justifiable.

Sub-family *Pentatominae*.

Forms examined: *Nezara viridula* L., *N. gramina* F., *Piezodorus lituratus* F., *Catacanthus incarnatus* Dru., *Tropicoris rufipes* L., *Bagrada picta* F., *Antestia lineaticollis*, *Dolycoris baccarum* L., *Carpocoris nigricornis* F., *Palomena prasina* L., *Erthesina fullo* Thunb., *Dalpada oculata* F., etc.

Nezara viridula. (Pl. VIII, fig. 16.)

Basal plates short and stout, prolonged dorsally into heavily chitinised struts. Phallosoma long, wide, but narrow near the mouth. Conjunctiva exposed (only partially invaginable), produced laterally into two flaps which point towards the posterior and enclose the short vesica. Distal region of conjunctiva membranous, having two thick chitinous patches in the lateral regions, meeting each other dorsally, corresponding to appendages No. 2. Vesica short. Ejaculatory reservoir very large. Parameres short, flat and deeply curved.

N. graminea. (Pl. VIII, fig. 17.)

Almost similar to the above. Conjunctiva appendages more elongated and parameres leaf-like.

Piezodorus lituratus. (Pl. VIII, fig. 18.)

Basal plates prolonged into still stouter struts. Phallosoma elliptical, shorter and wider. Conjunctiva permanently exposed only in the proximal region. Parameres narrower.

Catacanthus incarnatus. (Pl. VIII, fig. 19.)

Conjunctiva very large, mostly permanently exposed, produced into posteriorly directed flaps, the appendages very well developed, hard and free of the surface for some length; vesica longer; parameres elongated.

Tropicoris rufipes. (Pl. VIII, fig. 20.)

Basal foramen larger than that in the above forms, basal plates without long struts, otherwise quite similar to *Nezara*; parameres, however, much elongated and narrow.

Bagrada picta. (Pl. VIII, fig. 21.)

The conjunctiva flaps bilobed, the dorsal lobe hard and pointed. No conjunctiva appendages. Parameres flattened and curved.

Dolycoris baccarum. (Pl. VIII, fig. 22.)

This form differs from all the above Pentatominæ in several respects.

Basal plates delicate and not produced dorsally into struts. Phallosoma elongated. Conjunctiva neither permanently exposed in any region, nor produced into any flaps, etc., conjunctiva appendages very distinct and well developed. Vesica very long and curved.

Carpocoris nigricornis. (Pl. VIII, fig. 23.)

Unlike *Dolycoris* this resembles the previous forms in all the essentials. Conjunctiva without appendages (cf. *Bagrada*), vesica extremely elongated, bent in several places. Parameres flattened.

Remarks.—Distant (13) placed *Carpocoris* and *Dolycoris* in the same division, Carpocoraria, which seems hardly correct, according to the evidence of the male armature. *Carpocoris* seems to have affinities with genera like *Antestia* and *Bagrada*. Moreover, Distant put *Palomena* in this very division; the genitalia in this form are near to those in *Nezara*, etc.

Erthesina fullo.

Genitalia on the same plan as in *Nezara*.

Dalpada oculata. (Pl. VIII, fig. 24.)

Genitalia almost similar to those in *Piezodorus*, except in the shape of the parameres.

Distant placed this genus, along with *Erthesina*, in the division *Halyaria*, widely separated from *Nezaria*, containing *Nezara*, *Piezodorus*, etc.

Remarks.—The nature of the conjunctiva appendages and the vesica show that the Pentatomine type of genitalia resembles that in Plataspidae and Cydnidae, the latter being more advanced in having two or three pairs of conjunctiva appendages, elongated and stiff vesica, etc.

It may also be remarked that the Pentatomine type of genitalia is met with in the sub-families, *Asopinae* (p. 144), *Discocephalinae*, *Graphosominae* (p. 145), *Phyllocephalinae* (p. 148), etc.

Sub-family *Acanthosominae*.

Acanthosoma haemorrhoidale L. (Pl. VIII, fig. 25.)

Basal plates short and stout. Phallosoma oblong, fairly wide. Conjunctiva bearing only one pair of distinct appendages, originating from the distal lateral regions (No. 2). Vesica different from that in any other sub-family, very long, secondarily differentiated into three regions, two hard ones separated by a membranous one, which are telescoped into one another. Distal region of vesica very much elongated and flagellum-like. Ejaculatory reservoir small

and rounded in outline. Parameres long, slightly curved, wedge-shaped at the apices.

Remarks.—The structure of the vesica is characteristic of this sub-family.

Sub-family *Urostylinae.*

Urochela quadripunctata Dall. (Pl. IX, fig. 26.)

Basal plates short and curved. Phallosoma wide and short. Conjunctiva having a pair of membranous diverticula originating from its distal lateral region, below the central axis. Vesica wide and flattened, ejaculatory duct within it as wide and hardly more thick-walled. Ejaculatory reservoir round and small. Parameres long, slender, pointed at the apices.

Remarks.—The nature of basal plates, phallosoma and conjunctiva appendages bring the above type near to that in Acanthosomatinae. The vesica, however, differs in the two.

Sub-family *Dinidorinae.*

Aspongopus janus F. (Pl. IX, fig. 27.)

Basal plates large, thin and flattened. Phallosoma wide. Conjunctiva bearing two pairs of distinct appendages. Vesica short, wider at base, gradually tapering down in the distal region. Ejaculatory duct opens at the base of vesica into a very big, spongy organ (ejd^2) which tapers gradually and extends up to the gonopore; this organ evidently corresponds to the distal region of the ejaculatory duct, including the reservoir, in other Pentatomoideae. Parameres short and flattened.

Remarks.—The above genitalia are characteristic of the sub-family and come near to those in Tessaratominae.

Sub-family *Phyllocephalinae.*

Forms examined: *Megarhynchus rostratus* F., *Macrina juvenca* Burm., etc.

Megarhynchus rostratus. (Pl. IX, fig. 28.)

Genitalia are of the same form as in Pentatominae, e.g. *Nezara*, etc. Parameres are, however, characteristic of the form.

Sub-family *Tessaratominae.*

Forms examined : *Tessaratoma* sp. (probably *javanica* Thunb.), *Eurostus pratti* Dist., *Sepina seychellensis* Dist., etc.

Tessaratoma sp. (Pl. IX, fig. 29.)

Basal plates and phallosoma similar to those in *Aspongopus.* Conjunctiva membranous, bearing three pairs of distinct appendages (No. 1, 2 and 3), the second pair membranous, the other two solid and hard. Vesica long, cylindrical and stiff. The ejaculatory duct within it very thick and hard, with a very small lumen. Ejaculatory reservoir distinct. Parameres long, flat, bilobed in the distal region.

Eurostus pratti. (Pl. IX, fig. 30.)

Genitalia almost similar to those in *Tessaratoma.*

Basal plates more flattened. The 3rd pair of conjunctiva appendages small. Ejaculatory reservoir still indistinct. Parameres more distinctly bilobed in the distal region.

Sepina seychellensis. (Pl. IX, fig. 31.)

This genus differs in several respects from the above two genera of Tessaratominae.

Basal plates short and stout. Conjunctiva with only one pair of appendages. Vesica thin, wider and produced into a dorsal diverticulum in the proximal region, extremely narrow and thread-like distally. Ejaculatory duct traverses a solid bilobed structure (ejr) in the proximal region of the vesica, and is very narrow and only slightly thick-walled in its distal region. Parameres rod-like.

The single pair of conjunctiva appendages, short basal plates and the nature of the vesica remind us of the aedeagus in *Acanthosoma.*

Remarks.—The genitalia in this sub-family are on the same plan as in Dinidorinae. So Oshanin's arrangement should give way to that in the British catalogue (Saunders), where they are described one after the other.

Remarks on Pentatomoideae.

Basal plates rod-like, closely meeting each other but not fused in the median ventral line, often short but sometime produced dorsally into stout struts. Basal plates bridge

always present. Aedeagus always differentiated into distinct phallosoma, conjunctiva and vesica. Phallosoma long and tough. Conjunctiva membranous, its proximal region sometimes permanently exposed, hard and produced into two flaps pointing posteriorly. Conjunctiva appendages varying from one to three pairs in the different sub-families. Vesica elongated, hard and assuming different forms in the various sub-families, sometimes very small, *e.g.* Pentatominae. The ejaculatory duct shows two distinct regions throughout the family, it is thin-walled and narrow in the proximal region, extremely thick-walled and wide (but with small lumen) in its course through the vesica to which it gives its stiffness. The ejaculatory reservoir invariably present.

The three families treated here, Plataspidae, Cydnidae and Pentatomidae, have genitalia of the same type. Oshanin's arrangement of elevating the family Pentatomidae to the rank of a super-family is not supported by the structure of the genitalia.

The above type of genitalia has, however, several sub-types :—

(i) Pentatomine type—Phallosoma elliptical. Proximal region of conjunctiva permanently exposed and having only one pair of longitudinal thickenings. Vesica short, narrow, cylindrical. Ejaculatory reservoir very large. Found in Pentatominae, Graphosominae, Asopinae, Phyllocephalinae, Discocephalinae, etc.

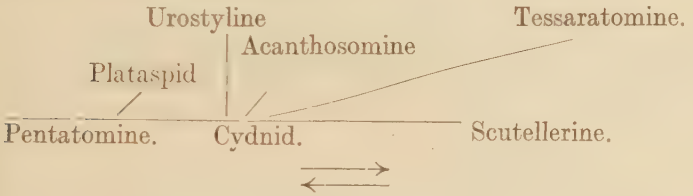
(ii) Cydnine type—Phallosoma cylindrical, conjunctiva bearing generally two pairs of longitudinal thickenings in the dorso-lateral and ventro-lateral regions, and these thickenings approaching the form of distinct appendages only in their distal regions. Vesica long, narrow, cylindrical and stiff. Ejaculatory reservoir small. Found in Cydnidae and Plataspidae.

(iii) Scutellerine type—Phallosoma funnel-shaped. Three pairs of distinct conjunctiva appendages. Vesica very wide and hard. Found in Scutellerinae, etc.

(iv) Tessaratomine type—Basal plates large and flat, whereas in the three previous sub-types the basal plates are short, stout and prolonged into large struts. Three pairs of distinct conjunctiva appendages. Ejaculatory reservoir not well marked off from the rest of the distal hard region of ejaculatory duct. Vesica cylindrical and long. Found in Tessaratominae, Dinidorinae, etc.

(v) Acanthosomine type—Basal plates short, only one pair of distinct conjunctiva appendages. Vesica very long, flagellum-like in the distal region, almost throughout distinct from the thick-walled but narrow ejaculatory duct. Ejaculatory reservoir small. Found in Acanthosominae. Genitalia in Urostylinae slightly modified from this.

The relationships of the above five types to one another can be expressed as follows :—



Super-fam. *Coreoideae.*

Family Coreidae.

Sub-family *Merocorinae.*

Hirilcus alternatus Dall. (Pl. IX, fig. 32.)

Basal plates thin, flat, comparatively wider in the lower regions, where they meet in the median ventral line. Basal plates-bridge well developed. Aedeagus differentiated into phallosoma, conjunctiva and vesica. Phallosoma long, cylindrical, comparatively wider and more delicate in the proximal region. Conjunctiva large, reaching the base of phallosoma in the invaginated condition; conjunctiva appendages three pairs, in the proximal dorsal, distal, lateral and proximal ventral regions respectively (No. 1, 2 and 3 of Pentatomidae). First and second pair heavily chitinised and flattened, the third narrow and delicate. Vesica very long, thick, cylindrical, straight, narrow and tapering in the distal region. Ejaculatory duct thick-walled and thrown into one or two coils in its course within the vesica; ejaculatory reservoir distinct. Parameres small, narrow, pointed at the apices.

Sub-family *Coreinae.*

Forms examined : *Homococerus inornatus* Stal., *Homococerus rosaceus* Dist. (= *Omanocoris variabilis* Dall., fide Kiritshenko, 1916), *Leptoglossus membranaceus* F., *Cletus stâli* Dist. (*nom. nov.* for *C. bipunctatus* Westw., *Anoplocnemis phasiana*, etc.

Homoeocerus inornatus. (Pl. IX, fig. 33.)

Phallosoma large and wide, especially in the proximal region. Conjunctiva with only one pair of appendages in the ventral region (No. 3). Vesica thrown into two coils in the middle of its length. Ejaculatory reservoir rounded. Parameres much expanded in the proximal region, blunt at the apices.

Homoeocerus rosaceus. (Pl. IX, fig. 34.)

This species differs from the above in having two pairs of conjunctiva appendages, No. 1 being also developed. Moreover, the parameres are expanded only at the extreme bases, otherwise they are narrow and slender.

Leptoglossus membranaceus. (Pl. X, fig. 35.)

Conjunctiva with one pair of appendages (No. 3), which are trilobed. Vesica wider in the proximal region, thrown into a spiral, heavily chitinised but membranised at the bends of the spiral and in its proximal region. Ejaculatory duct within vesica narrow, but extremely thick-walled, and thrown into one or two coils in the proximal region of vesica. Ejaculatory reservoir large, compressed in the transverse plane. Parameres wide in the proximal region, gradually tapering in the distal.

Cletus ståli. (Pl. X, fig. 36.)

Phallosoma short. Conjunctiva with only one pair of slender appendages (No. 3). Vesica thrown into one or two coils, thick. Ejaculatory reservoir rounded in outline. Parameres long and slender.

Sub-family *Pseudophloeinae.*

Clavigralla gibbosa Spin. (Pl. X, fig. 37.)

Phallosoma long. Conjunctiva bearing a pair of thin flat appendages (No. 3). Vesica almost straight, wide and membranous in the proximal region, pointed at the apex. Ejaculatory reservoir rounded, dorso-laterally produced into a pair of blunt growths, which appear as thickenings in the conjunctiva and thus may correspond to conjunctiva appendages No. 2 of Pentatomoideae. Parameres short.

Sub-family *Alydinae.*

Stenocephalus agilis Scop. (Pl. X, fig. 38.)

Phallosoma wide. Conjunctiva with indistinct thickenings in

ventral region, otherwise without any appendages. Vesica extremely long, flagellum-like, thin, the thick-walled ejaculatory duct within giving it the necessary strength. Ejaculatory reservoir rounded and having a pair of solid outgrowths in its dorso-lateral regions. Parameres short and twisted.

Remarks.—Distant put this genus as a separate division in the sub-family Pseudophloeinae. Oshanin, following Stål, put it in the Alydinae. In the British catalogue it alone constitutes a separate sub-family Stenocephalina. The structure of the genitalia suggests that this neither resembles Pseudophloeinae nor Alydinae; so that Saunders' arrangement of putting it in a separate family seems to be justified.

Riptortus linearis F. (Pl. X, fig. 39.)

Phallosoma wide, thin-walled in the proximal region. Conjunctiva bearing two pairs of distinct appendages in the dorso- and ventro-lateral regions (No. 1 and 3). Vesica short and rod-like, without any coil. Ejaculatory reservoir well developed, its dorso-lateral outgrowths very thick, pointing towards the apex of the aedeagus. Parameres straight, stout, and blunt at the apices.

Leptocorisa varicornis F. (Pl. X, fig. 40.)

Basal plates comparatively larger than in *Riptortus*. Phallosoma short and wide. Vesica narrower, longer and thrown into a coil. Parameres strong, and hook-like in the distal region.

Sub-family *Corizinae.*

Forms examined: *Corizus scotti* Dist., *Scrinetha* sp., *Myrmus miriformis* Fall., etc., etc.

Corizus scotti. (Pl. X, fig. 41.)

Basal plates large. Phallosoma wide, especially in the middle. Conjunctiva bearing a number of irregular appendages in its lateral regions. Vesica very long, thrown into a coil in its proximal region, flagellum-like distally. Ejaculatory reservoir well developed and laterally produced into a pair of outgrowths. Parameres short.

Remarks.—In the structure of the vesica *Corizus* comes near *Stenocephalus*.

Serinetha sp. (Pl. X, fig. 42.)

This form differs much from the above. Basal plates small. Phallosoma long and cylindrical. Conjunctiva bearing two pairs of distinct appendages in its lateral regions (No. 1 and 3). Vesica cylindrical, narrow, thrown into a coil in the proximal region. Ejaculatory reservoir with well-developed lateral outgrowths. Parameres long and slender.

Remarks on Coreidae.

The genitalia in this family are on the same general plan as in Pentatomoideae, those in the Merocorinae being very like those in the Tessaratominae. But a Coreid aedeagus can always be distinguished by the character of its vesica, which itself or the ejaculatory duct within it is always thrown into one or two coils. In forms like *Stenocephalus* the vesica is distinctly Lygaeid in type, but the presence of the conjunctiva appendages decides its Coreid nature, as the Lygaeidae are absolutely devoid of any such appendages.

The genitalia in the different sub-families as they stand at present are not quite distinct from one another. The Merocorinae can be separated from others by the presence of three distinct pairs of conjunctiva appendages. The sub-family Coreinae is only slightly distinct, being more or less specialised in the structure of the vesica. The remaining three sub-families, Pseudophloeinae, Corizinae and Alydinae, have almost the same type of genitalia, e.g. *Clavigralla* (Pseudophloeinae) is almost similar to *Serinetha* (Corizinae), and both are hardly distinct from *Riptortus* and *Leptocorisa* (Alydinae).

Series II. PHLOEOBIOTICA.

Super-fam. *Aradoideae.*

Family Aradidae.

Aradus depressus F. (Pl. X, fig. 43.)

Aedeagus differentiated into phallosoma, conjunctiva and vesica. Basal plates, as in Pentatomidae and Coreidae, thin and flat, their bridge well developed. Phallosoma large and wide, very thin in the proximal region, phallosoma-mouth extremely small. Conjunctiva bearing three or four pairs of irregularly distributed appendages.

Vesica very narrow, elongated, stiff, completely fused to the ejaculatory duct within. Ejaculatory reservoir small, round, with a pair of outgrowths in the dorso-lateral region. Parameres narrow, curved, and somewhat pointed at the apices.

Family Dysodiidae.

Mezira membranacea F. (Pl. X, fig. 44.)

Resembles *Aradus depressus*, except that the phallosoma is elongated, fairly thick, tapering in the distal region; conjunctiva with a single pair of appendages, and parameres stout and very much flattened.

Aneurus laevis F. (Pl. X, fig. 45.)

Differs from *Aradus* and *Mezira*, especially from the former, in several important points. Phallosoma fusiform. Endosoma undifferentiated into conjunctiva and vesica, large, covered with numerous small tubercles. No ejaculatory reservoir; ejaculatory duct narrow, short. Parameres long and almost straight.

Remarks on Aradoideae.

Both Saunders and Butler (7) put *Aradus* and *Aneurus* quite close to each other. Distant, however, arranged them in separate sub-families, Aradinae and Brachyrhynchinae, the latter including *Mezira* as well. In the structure of the genitalia *Mezira* is nearer to *Aradus* than to *Aneurus*; the latter, in fact, is so different from either of the two (non-differentiation of the endosoma into conjunctiva and vesica, absence of the ejaculatory reservoir, etc.), that it should not only be put in a separate family (Dysodiidae) as is done by Reuter and Oshanin, but this family should be considered quite distinct from Aradidae. *Mezira*, however, should go to Aradidae.

The majority of the old Rhynchotists considered this family allied to Tingitidae: Saunders, Distant, Kirkaldy (33), Osborn (43), Handlirsch (23), etc. Reuter (48) put it near his series Anonychia (Reduviidae, Capsidae, etc.), but later on (49) he put it in a distinct series by itself, the Phloeobiotica, and placed this series between the Polyneuria (Pentatomoideae, Coreidae, etc.), and the Onychiophora (Lygaeidae, etc.). In the structure of the genitalia—differentiation of the aedeagus into phallosoma, conjunctiva and vesica, structure of the basal plates, nature

of the conjunctiva appendanges, etc.—*Aradus* and *Mezira* (Aradidae) closely resemble Pentatomidae, Coreidae, Lygaeidae, etc., and, in fact, do not even deserve to be put in a separate series. The genus *Aneurus* (Dysodiidae), however, as pointed out already, is quite distinct from the Aradidae, except for the structure of the basal plates. In the non-development of the vesica it has a point of similarity to Tingitidae, etc.

Series III. ONYCHIOPHORA.

Super-fam. *Lygaeoideae.*

Phal. *Lygaeiformes.*

Family Berytidae.

Forms examined : *Berytus minor* H. S., *B. clavipes* F., *Metatropis rufescens* H. S., *Metacanthus punctipes* Germ., *Hubertiella cardamomi* Kirk., etc.

Berytus minor. (Pl. X, fig. 46.)

Aedeagus differentiated into phallosoma, conjunctiva and vesica. Basal plates rod-like, slightly flattened. Phallosoma short and wide. Conjunctiva without any appendages, except for a pair of insignificant thick patches in the lateral regions. Vesica very much elongated, flagellum-like, comparatively wider and produced into diverticula in the proximal region, thin and free from the thick-walled ejaculatory duct within. Ejaculatory reservoir rounded and compressed in the dorsal region. Parameres slender, elongated, narrow, slightly wider in the proximal region.

Hubertiella cardamomi. (Pl. XI, fig. 47.)

Basal plates stouter. Conjunctiva wholly membranous. Vesica not produced into any distinct diverticulum. Parameres flattened and plate-like.

Remarks.—The absence of any distinct conjunctiva appendage, the elongated and flagellum-like nature of the vesica, etc., bring the Berytid type of genitalia quite close to that common in *Lygaeidae*, but the latter is distinguished by the entire absence of any conjunctive appendages or thickening even (vide infra). Dallas and Uhler treated Berytidae as allied to Coreidae. Stål (En. Hem. IV, 1874) considered it as a sub-family of Lygaeidae.

The structure of the genitalia confirms the conclusions of Reuter and Oshanin, who put Berytidae close to Lygaeidae, but distinct from it.

Family Colobathristidae.

Phaenacantha australica Kirk. (Pl. XI, fig. 48.)

Basal plates thin, narrow, and not curved or expanded in their lower regions. Phallosoma long, wide and thick-walled in the proximal region, membranous and narrow in the distal. Conjunctiva large and without any appendage. Vesica extremely narrow, cylindrical, thin, and the thick-walled, narrow ejaculatory duct within quite visible; vesica thrown into loose coils resembling a spiral when in a state of rest. Ejaculatory reservoir conspicuous, narrower in the ventral region, wider in the dorsal and without lateral outgrowths. Parameres narrow in the proximal regions, very much expanded and slightly curved in the distal, and pointed at the apices.

Remarks.—The above genitalia are distinctly of the Lygaeid type. In the extreme elongation of the conjunctiva they come near to those in Heterogastrinae and Pachygronthinae. It is highly doubtful whether the arrangement of Oshanin in elevating "Colobathristinae," previously treated as a sub-family of Lygaeidae, to the rank of a separate family, is warranted.

Family Lygaeidae.

Sub-family *Lygaeinae.*

Forms examined: *Spilostethus pandurus* Scop., *S. hospes* F., *S. saxatilis* Scop., *Graptostethus servus* F., *Lygaeosoma reticulatum* H. S., *Arocatus sericans* Stal., *Nysius minor* Dist., etc.

Spilostethus pandurus Scop. (Pl. XI, fig. 49.)

Basal plates same as in Pentatomidae and Coreidae. Phallosoma wide, much longer and more strongly chitinised in the lateral regions than dorsally or ventrally, the dorsal surface being a thin membrane. Conjunctiva without any appendages or thickenings, its proximal region fused to the inside of the distal region of phallosoma. Vesica thin, except for the presence of a few irregular, spiral and thick patches in its proximal region, very long, thrown

into several loose coils, wider in the proximal region, and narrower in the distal, distinct from the thick-walled ejaculatory duct within, which is narrower where the vesica is wide and wider where the vesica is narrow. Ejaculatory reservoir narrow in its ventral region, and flattened dorso-ventrally. Parameres resembling a pair of shoes.

Graptostethus servus. (Pl. XI, fig. 50.)

Resembles the above except that the basal plates are very much expanded in their ventral region, the phallosoma is narrower in the proximal region, the vesica is still more elongated, thread-like, coiled, and the parameres are broad and rounded in the proximal region, flattened and twisted in the middle, and narrow in the distal region.

Arocatus sericans. (Pl. XI, fig. 51.)

Differs from the above in having phallosoma cylindrical and of uniform width, vesica extremely narrow, parameres flattened.

Sub-family *Chauliopinae.*

Chauliops lobatula Bredd. (Pl. XI, fig. 52.)

Resembles the Lygaeinae except that the vesica is extremely narrow throughout, the ejaculatory reservoir is rounded and the parameres are delicate and comparatively flattened in the distal region.

Remarks.—This genus was included amongst the Heterogastrinae by Distant. The genitalia in *Chauliops* are quite different from those in Heterogaster (vide infra), thus the conclusions of Oshanin are confirmed.

Sub-family *Cyminae.*

Ischnorhynchus ericae Horv. (Pl. XI, fig. 53.)

The advance in structure over that in the previous sub-families is in the enormous elongation and fineness of the vesica. The shape of the parameres is characteristic of the form.

Sub-family *Blissinae.*

Blissus sp. (Pl. XI, fig. 54.)

Differs from the previous sub-families in the structure of the vesica, which is short, wide, thick, with additional patches in the proximal region, coiled and resembling a clock's spring in the distal, and in the form of the parameres.

Sub-family *Henestarinae.*

Henestaris laticeps Curt. (Pl. XI, fig. 55.)

Resembles *Lygaeus militaris*, except that the vesica is shorter and the parameres are flattened in the proximal region, and forked at the bases.

Sub-family *Geocorinae.*

Geocoris thoracicus Fieb. (Pl. XI, fig. 56.)

Genitalia almost similar to those in *Ischnorhynchus* (Cyminae). The parameres are, however, different, they are straight and flattened in the basal region, curved and narrow in the distal.

Sub-family *Heterogastrinae.*

Heterogaster urticae Fabr. (Pl. XI, fig. 57.)

The genitalia differ in several respects from those in the previous sub-families. Phallosoma large, narrow in the proximal region, wide in the middle and very much narrower round its mouth, which is very small. Conjunctiva enormously long, folded in a zigzag (Z) fashion in the condition of repose. Vesica short, very stiff, compressed, flattened in its distal region and pointed at the apex. Vesica completely fused to the ejaculatory duct within, which is very much thickened, leaving only a narrow lumen in the centre, a feature unusual in Lygaeidae. Ejaculatory reservoir imperceptibly continuous with the vesica and differing from that in all other Lygaeidae in its outline.

Remarks.—The above genitalia in the extreme elongation of the conjunctiva, the form of the phallosoma and vesica, etc., come near those in the next sub-family, Pachygronthinae.

Sub-family *Pachygronthinae.*

Pachygrontha longiceps Stal. (Pl. XII, fig. 58.)

Almost resembles *Heterogaster* except that the vesica is elongated, extremely narrow, thread-like and delicate; the ejaculatory reservoir is only thinly chitinised except in its proximal region, and the parameres are short and flattened.

Remarks.—The genitalia in Pachygronthinae and Heterogastrinae remind us somewhat of those in the *Aradidae* (figs. 43 and 44).

Sub-family *Oxycareninae.*

Oxycarenus laetus Kirby. (Pl. XII, fig. 59.)

Basal plates large. Phallosoma short and wide. Vesica extremely narrow, except at the base, enormously elongated and coiled like a rope, as in *Ischnorhynchus* and *Geocoris*. Ejaculatory reservoir rounded, with large outgrowths in the dorso-lateral regions (cf. Coreidae). Parameres flat in proximal region, narrower and curved in the distal.

Remarks.—The above type of genitalia recalls that in *Stenocephalus*, fig 38 (Coreidae).

Sub-family *Aphaninae.*

Forms examined : *Rhyparochromus chiragra* F., *Tropistethus holosericeus* Schltz., *Peritrechus geniculatus* Hhn., *Trapezonotus arenarius* L., *Aphanus sordidus* F., *Emblethis verbasci* F., *Drymus brunneus* Sahlb., *Gastrodes ferrugineus* L., *Dieuches annulatus* Sign., *Metochus uniguttatus* Thunb., etc.

Aphanus sordidus. (Pl. XII, fig. 60.)

Basal plates very large. Phallosoma short and wide. Vesica narrow and enormously elongated as in *Ischnorhynchus* and *Oxycarenus*. Ejaculatory reservoir large and compressed in the transverse plane. Parameres long and slender.

Trapezonotus arenarius. (Pl. XII, fig. 61.)

The genitalia are very different from those in the above form. Basal plates short. Phallosoma short and narrow. Vesica much shorter, wider in the proximal region.

Remarks.—The genitalia in *Trapezonotus* remind us of those in Berytidae (figs. 46 and 47).

Drymus brunneus. (Pl. XII, fig. 62.)

Basal plates and phallosoma as in the above form. Vesica short, thin and wider in the proximal region, thick-walled and narrow in the distal, where its wall comes in contact with the ejaculatory duct. Parameres short, flattened, and pointed at the apices.

Remarks.—The genitalia in this form come near those in *Blissus* (fig. 54), *Henestaris* (fig. 55), etc.

Remarks on Lygaeidae.

The above genitalia are on the same plan as those in Pentatomidae, Coreidae and Aradidae, and can be distinguished from them in the total absence of conjunctiva appendages, and in the extreme elongation and fineness of the vesica. Some Coreidae, e.g. *Stenocephalus*, have a very long vesica, but the conjunctiva in them is still ornamented. Moreover, the Lygaeidae come near the Coreidae in the flattened nature of the basal plates and in the general outline of the ejaculatory reservoir. As will be shown hereafter, the Pyrrhocoridae connect the two families. The Pachygronthinae, however, come near Aradidae.

Amongst the ten different sub-families into which the Lygaeidae are usually divided there are only two types of genitalia; one of these primary types is capable of being divided into two sub-types. The Heterogastrinae and Pachygronthinae form one group. The Lygaeinae, Blissinae and Henestrinae resemble one another in having a comparatively shorter and wider vesica, while in the Cyminae, Chauliopinae, Geocorinae, Oxycareninae and Aphaninae the vesica is enormously elongated and flagellum-like; however in *Drymus brunneus*, amongst the Aphaninae, the vesica is similar to that in the former group.

Phal. *Pyrrhocoriformes.*

Family Pyrrhocoridae.

Sub-family *Larginae.*

Largus ruficennis Lap. (Pl. XII, fig. 63.)

Aedeagus differentiated into phallosoma, conjunctiva and vesica. Basal plates thin, narrow, flat, especially expanded in the ventral region (cf. Coreidae and Lygaeidae). Phallosoma cylindrical. Conjunctiva without any appendages (cf. Lygaeidae). Vesica elongated, thin-walled, wider in the proximal region, narrow in the distal, ejaculatory duct within, thick-walled and narrow. Ejaculatory reservoir rounded with lateral outgrowths in the dorso-lateral regions. Parameres very much flattened, bent and comparatively narrower in the distal region, and pointed at the apices.

Remarks.—The above type of genitalis is intermediate between that in Coreidae and Lygaeidae, coming nearer the latter in the structure of conjunctiva and vesica.

Sub-family *Pyrrhocorinae.*

Forms examined : *Antilochus coqueberti* F.. *Melamphaus fulvomarginatus* Dohrn., *Odontopus varicornis* F., *Dysdercus cingulatus* F., etc.

Antilochus coqueberti. (Pl. XII, fig. 64.)

Phallosoma elongated, with a pair of small projections in the lateral regions. Conjunctiva with three pairs of appendages in dorsal, disto-lateral and latero-ventral regions, corresponding to appendage No. 1, 2, 3 in the previous families. The second pair partially fused to the dorso-lateral region of the globular ejaculatory reservoir, thus providing a condition slightly more primitive than that in Coreidae. The third pair, as is common in Coreidae, is forked and appears as two pairs of appendages. Vesica short, straight, wider in the proximal region, tapering in the distal, stiff, and completely fused to the ejaculatory duct. Parameres very much elongated, sharply bent in the proximal region.

Odontopus varicornis. (Pl. XII, fig. 65.)

Phallosoma comparatively wider and shorter, having lateral projections which are very much smaller than those in *Antilochus*. Ejaculatory reservoir globular and very large. Parameres elongated and curved.

Dysdercus cingulatus. (Pl. XII, fig. 66.)

Phallosoma much wider than in the above forms. Two pairs of conjunctiva appendages, No. 1 and 3, the latter being forked into several lobes. Ejaculatory reservoir rounded in outline. Parameres shorter.

Remarks.—The genitalia in the two sub-families, Pyrrhocorinae and Larginae, are quite distinct. In the former they are similar to those in the Coreidae, in the structure of the conjunctiva appendages, the vesica and the ejaculatory reservoir, while in the Larginae they are of the Lygaeid type as already pointed out. Hence the position of the Pyrrhocoridae should be between Coreidae and Lygaeidae, nearer the former and not after the latter as it is usually considered to be by most Rhynchotists (Oshanin Distant, etc.). Saunders treated this family even as a sub-family " Pyrrhocorina " of Lygaeidae. In fact, the structure of genitalia suggests the abolition of this family altogether, putting the Largine genera in Lygaeidae and the Pyrrhocorine genera in Coreidae.

Series IV. ANONYCHIA.

Super-fam. *Tingitoideae.*

Family Tingitidae.

Forms examined: *Tingis cardui* L., *Urentius echinus* Dist., *Dictyonota fuliginosa* Costa., *Monanthia globulifera* Walk., *Teleonemia nilgirina* Bergr., etc.

Urentius echinus. (Pl. XII, fig. 67.)

Aedeagus different from that in any of the three series considered before: it is differentiated into phallosoma and endosoma, but the latter is not again differentiated into conjunctiva and vesica. And the basal plates are actually fused with each other in the median line. No ejaculatory reservoir, an organ of constant occurrence in the previous three series.

Phallosoma fusiform, almost membranous, except in the extreme distal region, which lies bent over the proximal. Endosoma bearing a thick patch in its proximal region, produced into two large lateral diverticula (ends.dv) in its distal region, just before becoming continuous with the ejaculatory duct. Parameres broad in the proximal region, narrow in the distal and pointed at the apices.

Dictyonota fuliginosa. (Pl. XII, fig. 68.)

Endosoma wholly membranous, very long, thrown into a fold, assuming "Z" shape, and produced into two almost straight lateral diverticula in its distal region. Ejaculatory duct imperceptibly continuous with the endosoma. Parameres more flattened than in *Urentius* and considerably narrowed in the distal region.

Family Piesmidae.

Piesma quadrata Fieb. (Pl. XII, fig. 69.)

Phallosoma wider in the proximal region, narrow and elongated in the distal, heavily chitinised in the proximal dorsal region, otherwise quite membranous. Endosoma naturally very narrow and indistinguishable from the ejaculatory duct. Parameres flattened in the proximal two-thirds, narrowed and pointed in the distal region.

Remarks on Tingitoideae.

In the complete fusion of the basal plates, non-differentiation of endosoma into conjunctiva and vesica, absence

of ejaculatory reservoir and the simple nature of the ejaculatory duct itself, the Tingitoideae are distinguished from the families of the three previous series and brought close to Reduviidae, etc. (vide infra). Therefore the arrangement followed in the British catalogue, by Distant, by Reuter, and almost all other Rhynchotists in placing "Tingididae" as if it were allied to Lygaeidae, etc. is not supported by the structure of the genitalia. Neither is Osborn's system of grouping this family with Acanthiidae and Aradidae correct. Oshanin also in his old catalogues (1906 and 1912) considered *Tingitoideae* to be allied to Lygaeidae, Pyrrhocoridae, etc., and it is only in his recent arrangement (1916) that he has separated this group from the Onychiophora (Berytidae, Lygaeidae, Pyrrhocoridae, etc.), and included it among the Anonychia (Reduviidae, Capsidae, etc.), an arrangement fully supported by the present study.

Oshanin elevated Tingitidae and Piesmidae to the rank of distinct families, while all previous specialists treated them as sub-families. The genitalia are distinct in the two, but not to such a degree as to warrant their being regarded as separate families.

Super-fam. *Reduvioideae.*

Phal. *Reduviiformes.*

Family Phymatidae.

Phymata erosa Lin. (Pl. XIII, fig. 70.)

Aedeagus differentiated into phallosoma and endosoma, but the latter not differentiated into conjunctiva and vesica.

Basal plates enormously elongated, deeply curved, their dorsal ends very well developed, large and bulbous. From their point of fusion in the mid-ventral line, two well-developed chitinous rods (st) start, which most probably correspond to the arms of the basal plates bridge of the previous series; these struts give strength and stiffness to the phallosoma. Phallosoma very long, membranous, only slightly thickened in the distal dorsal region, wider in the proximal region, narrow and cylindrical in the distal, the latter bent over the proximal. Endosoma membranous, without any appendages, thrown into numerous folds. Ejaculatory duct short. Parameres elongated, curved and pointed at the apices.

Remarks.—The genitalia are almost the same as in Reduviidae (vide infra), therefore, the arrangement of Distant, etc. of putting Phymatidae between Tingididae and Aradidae is obviously unsound.

Family Reduviidae.

Sub-family *Saicinae.*

Saica tibialis Stål. (Pl. XIII, fig. 71.)

Basal plates and their two struts similar to those in *Phymata*. Phallosoma long, slightly constricted in the middle, distinctly lobed in the region of the mouth, membranous except for a pair of thick longitudinal patches on the distal dorsal surface. Endosoma very large, smooth except for a pair of slender appendages in the proximal dorsal region and numerous small tubercles in the distal. Parameres originating from near the posterior margin of the IXth segment, narrow and slender.

Sub-family *Tribelocephalinae.*

Tribelocephala comparanda Bergr. (Pl. XIII, fig. 72.)

Basal plates thin, their region of fusion large and compressed to assume a platform-like appearance, from the posterior margins of which arise the two struts. Phallosoma deeply constricted in the middle. Endosoma with a patch of thick longitudinal folds (resembling a fan) in the proximal region, and numerous minute tubercles on the rest of the surface. Parameres stout, large, slightly curved and blunt at the apices.

Sub-family *Stenopodinae.*

Stenopoda culiciformis F. (Pl. XIII, fig. 73.)

Almost resembles *Tribelocephala*, except that the endosoma has a pair of thick diverticula (ends.th) in the proximal dorsal region, and the parameres are more flattened.

Sub-family *Salyavatinae.*

Petalochirus umbrosus H. S. (Pl. XIII, fig. 74.)

Basal plates stout and compressed, with a large and bulbous region of fusion; the struts very well developed. Phallosoma shorter and wider. Endosoma shorter than in the previous sub-families, thickened at several places. Parameres large and flat.

Sub-family *Reduviinae.*

Velitra rubropicta A. S. (Pl. XIII, fig. 75.)

Resembles *Petalochirus*, except that the endosoma is almost smooth, with only a few minute tubercles in the distal region, and the parameres are almost straight, and are hook-shaped at the apices.

Sub-family *Piratinae.*

Pirates hybridus Scop. (Pl. XIII, fig. 76.)

Basal plate struts delicate. Endosoma smooth. Parameres flattened.

Sub-family *Ectrichodiinae.*

Physorhynchus crux Thunb. (Pl. XIII, fig. 77.)

Resembles *Pirates* except that the basal plates are rod-like and curved, and the endosoma has a pair of membranous diverticula in the proximal dorsal region (ends.dv).

Ectrichodia crudelis Stål. (Pl. XIII, fig. 78.)

Differs from the above in the fact that the endosoma has a pair of thickenings (ends.st) instead of diverticula in the proximal dorsal region.

Sub-family *Hammatocerinae.*

Hammatocerus conspicillaris Dru. (Pl. XIII, fig. 79.)

The genitalia differ in several respects from those in other sub-families, they remind us of those in Tingitidae.

Basal plates extremely delicate and slender, except in their dorsal region; their struts in close contact with each other. Phallosoma enormously elongated with a narrow mouth. Endosoma smooth. Parameres elongated, deeply curved and pointed at the apices.

Sub-family *Apiomerinae.*

Apiomerus pilipes F. (Pl. XIII, fig. 80.)

Genitalia on the same plan as those in Reduviinae, the struts of the basal plates are, however, insignificant and the phallosoma is heavily thickened in the distal dorsal region, the thickenings being prolonged in the posterior direction. Parameres long, deeply curved and narrow in the distal region.

Sub-family *Harpactorinae.*

Forms examined : *Cosmolestes picticeps* Stål., *Velinus nigrigenu* A. and S., *Sycanus collaris* F., *Endochus inornatus* Stal., *Occamus typicus* Dist., etc.

Cosmolestes picticeps. (Pl. XIII, fig. 81.)

Basal plates short and slender, their struts delicate. Phallosoma short. Endosoma enormously large, with a number of short spines in the dorsal region. Parameres slender, rod-like and blunt at the apices.

Velinus nigrigenu. (Pl. XIV, fig. 82.)

Endosoma bearing six rows of conical spines, so arranged as to give to the part the form of a trifoliate leaf. Parameres longer.

Endochus inornatus. (Pl. XIV, fig. 83.)

Basal plates longer than those in the above forms. Endosoma with three patches of spines arranged like a triangle.

Occamus typicus. (Pl. XIV, fig. 84.)

Differs in several respects from all the above. Phallosoma longer ventrally, extending as a pair of elongated lobes below and beyond the mouth. Endosoma quite smooth. Parameres very delicate.

Remarks on Reduviidae.

In the non-differentiation of endosoma, structure of the ejaculatory duct, etc., the above type of genitalia is similar to that in Tingitidae, from which it can be distinguished by the nature of the basal plates and their struts, the latter being altogether absent in that group, and by the form of the phallosoma.

There are practically no sub-types of genitalia corresponding to the various sub-families into which the Reduviidae are divided. Leaving out Hammatocerinae, the other sub-families differ very little from one another in this respect, and it is highly doubtful whether the division of the family into so many groups is justifiable. Taking even minute details (as compared with other families) at the most only three groups can be made out : the Saicinae, Tribelocephalinae and Stenopodinae resemble one another

Super-fam. *Cimicoideae.*
Phal. *Cimiciformes.*
Family Cimicidae.

Cimex lectularius L. (Pl. XIV, fig. 89.)

Specialised in several respects.

Genitalia as well as the posterior abdominal segments asymmetrical, turned towards the left. Basal plates thin, inconspicuous except in their dorsal region. Phallosoma wide in the proximal region, very much narrowed and elongated in the distal, the latter lodging in a groove on the mesial face of the huge left paramere. Endosoma smooth. Ejaculatory duct short and narrow. Parameres, one (the right) being not developed at all, more asymmetrical than those in almost any other Rhynchotous family; the left, however, enormously developed, about twenty times larger than the aedeagus itself.

Remarks.—On account of the huge size of the paramere, almost all the investigators, Landois (34), Hase (24), Murray (40), etc., except Cragg and Christophers (11) mistook it for the aedeagus or "penis." As above mentioned, this paramere carries the aedeagus and actually penetrates the vagina during copulation, the soft aedeagus being alone unable to do so. The genitalia can be derived from those in the sub-family Bryocorinae (Capsidae) (p. 173).

Family Anthocoridae.

Forms examined: *Anthocoris nemoralis* F., *A. sylvestris* L., *Acompocoris pygmaeus* Fall., etc.

Anthocoris nemoralis. (Pl. XIV, fig. 90.)

Genitalia essentially similar to those in Cimicidae, but less specialised. Basal plates and phallosoma more heavily chitinised, the latter not so much elongated in the distal region. The paramere (left) smaller than in *Cimex*. The IXth segment also less asymmetrical.

Remarks.—Distant and Kirkaldy considered this family entirely distinct from Cimicidae. Handlirsch and Reuter put it near the latter, but forming a distinct family: the structure of the genitalia suggests that the two are still nearer and deserve to be considered as sub-families only.

Phal. *Capsiformes.*

Family Capsidae.

Sub-family *Capsinae.*

Tribe *Capsaria.*

Forms examined: *Phytocoris ulmi* L., *Megacoelum mimicum* Dist., *Calocoris norvegicus* Gmel., *Stenotus binotatus* F., *Dichrooscytus rufipennis* Fall., *Lygus spinolae* Mey., *L. lucorum* Mey., *Pocciloscytus unifasciatus* F., *Camptobrochis lutescens* Schill., *Capsus ater* L., etc.

Calocoris norvegicus. (Pl. XIV, fig. 91.)

Both the IXth abdominal segment and the genitalia asymmetrical in position, turned towards the left.

Basal plates thin, flattened, especially in the lower regions completely fused with each other. Phallosoma long, delicate, wide proximally, tapering and narrowed in the distal region. Endosoma differentiated into conjunctiva and vesica. Conjunctiva smooth, without any appendages, its proximal region permanently fused to the inside of the phallosoma, so that even in the condition of complete eversion it being not wholly exposed. Vesica quite different from that in any of the previous families, large and narrow proximally, wide and very much expanded in the distal region where it is produced into four diverticula (vs.dv), three of which become subsequently solidified; free from the ejaculatory duct within, which is thick and conspicuous, but shorter than the vesica, so that the gonopore lies about the middle on the dorsal surface instead of at the apex. Gonopore wide and thick-rimmed. The ejaculatory duct just after entering the basal foramen very much swollen, probably owing to the fusion with it of the basal plates bridge in that region. No ejaculatory reservoir. Parameres originating from near the posterior lateral margins of the IXth segment, asymmetrical, the right shorter than the left, both resembling thin narrow plates.

Phytocoris ulmi. (Pl. XIV, fig. 92.)

Similar to *Calocoris* except that the vesica in its distal region is produced into several indefinite diverticula or lobes, which are, moreover, all membranous. Right paramere resembling a thin narrow plate, tapering in the distal region to a pointed apex; the left, very broad at the base, twisted in the middle, and blunt at the apex.

Super-fam. *Cimicoideae.*

Phal. *Cimiciformes.*

Family Cimicidae.

Cimex lectularius L. (Pl. XIV, fig. 89.)

Specialised in several respects.

Genitalia as well as the posterior abdominal segments asymmetrical, turned towards the left. Basal plates thin, inconspicuous except in their dorsal region. Phallosoma wide in the proximal region, very much narrowed and elongated in the distal, the latter lodging in a groove on the mesial face of the huge left paramere. Endosoma smooth. Ejaculatory duct short and narrow. Parameres, one (the right) being not developed at all, more asymmetrical than those in almost any other Rhynchotous family; the left, however, enormously developed, about twenty times larger than the aedeagus itself.

Remarks.—On account of the huge size of the paramere, almost all the investigators, Landois (34), Hase (24), Murray (40), etc., except Cragg and Christophers (11) mistook it for the aedeagus or "penis." As above mentioned, this paramere carries the aedeagus and actually penetrates the vagina during copulation, the soft aedeagus being alone unable to do so. The genitalia can be derived from those in the sub-family Bryocorinae (Capsidae) (p. 173).

Family Anthocoridae.

Forms examined: *Anthocoris nemoralis* F., *A. sylvestris* L., *Acompocoris pygmaeus* Fall., etc.

Anthocoris nemoralis. (Pl. XIV, fig. 90.)

Genitalia essentially similar to those in Cimicidae, but less specialised. Basal plates and phallosoma more heavily chitinised, the latter not so much elongated in the distal region. The paramere (left) smaller than in *Cimex*. The IXth segment also less asymmetrical.

Remarks.—Distant and Kirkaldy considered this family entirely distinct from Cimicidae. Handlirsch and Reuter put it near the latter, but forming a distinct family: the structure of the genitalia suggests that the two are still nearer and deserve to be considered as sub-families only.

Phal. *Capsiformes.*

Family Capsidae.

Sub-family *Capsinae.*

Tribe *Capsaria.*

Forms examined: *Phytocoris ulmi* L., *Megacoelum mimicum* Dist., *Calocoris norvegicus* Gmel., *Stenotus binotatus* F., *Dichrooscytus rufipennis* Fall., *Lygus spinolae* Mey., *L. lucorum* Mey., *Poecilocytus unifasciatus* F., *Camptobrochis lutescens* Schill., *Capsus ater* L., etc.

Calocoris norvegicus. (Pl. XIV, fig. 91.)

Both the IXth abdominal segment and the genitalia asymmetrical in position, turned towards the left.

Basal plates thin, flattened, especially in the lower regions, completely fused with each other. Phallosoma long, delicate, wide proximally, tapering and narrowed in the distal region. Endosoma differentiated into conjunctiva and vesica. Conjunctiva smooth, without any appendages, its proximal region permanently fused to the inside of the phallosoma, so that even in the condition of complete eversion it being not wholly exposed. Vesica quite different from that in any of the previous families, large and narrow proximally, wide and very much expanded in the distal region where it is produced into four diverticula (vs.dv), three of which become subsequently solidified; free from the ejaculatory duct within, which is thick and conspicuous, but shorter than the vesica, so that the gonopore lies about the middle on the dorsal surface instead of at the apex. Gonopore wide and thick-rimmed. The ejaculatory duct just after entering the basal foramen very much swollen, probably owing to the fusion with it of the basal plates bridge in that region. No ejaculatory reservoir. Parameres originating from near the posterior lateral margins of the IXth segment, asymmetrical, the right shorter than the left, both resembling thin narrow plates.

Phytocoris ulmi. (Pl. XIV, fig. 92.)

Similar to *Calocoris* except that the vesica in its distal region is produced into several indefinite diverticula or lobes, which are, moreover, all membranous. Right paramere resembling a thin narrow plate, tapering in the distal region to a pointed apex; the left, very broad at the base, twisted in the middle, and blunt at the apex.

Stenotus binotatus. (Pl. XIV, fig. 93.)

Vesica produced into four or five short diverticula which are covered with minute tubercles. Ejaculatory duct within the vesica still shorter, gonopore in the proximal region.

Dichrooscytus rufipennis. (Pl. XV, fig. 94.)

Phallosoma shorter and wider. In addition to the usual diverticula the vesica bears a long spine-like process (vs.sp) originating from its proximal region. The ejaculatory duct within the vesica not conspicuously thickened or widened, gonopore in the distal region.

Lygus spinolae. (Pl. XV, fig. 95.)

Of the vesica diverticula two dorsal in position solidified and pointed at the apices, the rest covered with minute tubercles. The ejaculatory duct just before entering the vesica having a spiral lining. The left paramere expanded in the proximal region, the right in the distal.

Camptobrochis lutescens. (Pl. XV, fig. 96.)

Vesica very long, membranous throughout, except for two or three isolated thick patches, and unlike that in any of the above forms, neither flattened nor produced into any diverticulum in its distal region, rather markedly narrow there. Gonopore in the proximal region.

Remarks.—The above genitalia remind us of those in some Miraria (vide infra).

Capsus ater. (Pl. XV, fig. 97.)

Vesica extremely large, protruding out of the phallosoma mouth, produced into four slightly thick-walled diverticula. As in *Dichrooscytus* a long solid process present, originating from the junction of conjunctiva and vesica. The left paramere deeply curved, narrower; the right slightly flattened.

Tribe *Miraria.*

Forms examined: *Acetropis gimmerthali* Flor., *Stenodema laevigatum* L., *S. holsatum* Fall., *Notostira erratica* L., *Teratocoris antennatus* Boh., *Miris dolobratus* L., *M. ferrugatus* Fall., etc.

Acetropis gimmerthali. (Pl. XV, fig. 98.)

Basal plates, phallosoma and conjunctiva only slightly differing from those in Capsaria. Vesica shorter, stiff beyond the gonopore, resembling an appendage, not lobed or produced into any diverticulum. A pair of distinct vesica appendages (vs.app) present, originating from its proximal region. The left paramere, as in Capsaria, larger and more twisted than the right.

Stenodema laevigatum. (Pl. XV, fig. 99.)

Phallosoma elongated, cylindrical, with a large and wide mouth. Vesica large, extending much beyond the gonopore, covered with numerous tubercles in the distal region, without any appendage.

Notostira erratica. (Pl. XV, fig. 100.)

In essentials resembles *Stenodema*, the vesica, however, much expanded and differently sculptured, bearing one large and fairly thick patch just posterior to the gonopore, and a small one in the lateral region. The left paramere very deeply twisted.

Teratocoris antennatus. (Pl. XV, fig. 101.)

In essentials resembles *Acetropis*. The part of vesica beyond the gonopore assumes the form of a well-defined appendage. A pair of well-developed appendages originate from the proximal region of the vesica, one of which (left) is narrow while the other is very much flattened. The left paramere narrower and twisted.

Miris dolobratus. (Pl. XV, fig. 102.)

Phallosoma fusiform. Vesica shorter than in any of the above forms, as long as the ejaculatory duct, with the gonopore at the distal end. A pair of long vesica appendages present, in addition there are one or two small conical processes as well. The left paramere much expanded in its proximal region, narrower and twisted in the distal; the right straight and flat.

Sub-family *Bryocorinae.*

Monalocoris filicis L. (Pl. XV, fig. 103.)

The Bryocorinae differ from all other sub-families except the Dicyphinae, in having no differentiated vesica.

Phallosoma long, narrow, especially in the distal region, the phallosoma mouth being very small. Endosoma undifferentiated

into conjunctiva and vesica, without any appendages. The asymmetry of the parameres is specially well marked, the right being extremely small.

Remarks.—The above genitalia show an approach to those in Cimicidae, where the right paramere is totally absent, and the endosoma is not differentiated into conjunctiva and vesica.

Sub-family *Dicyphinae.*

Forms examined : *Macrolophus nubilus* H. S., *Dicyphus constrictus* Boh., *D. pallidicornis* Fieb., etc.

Dicyphus constrictus. (Pl. XV, fig. 104.)

As above remarked, the Dicyphinae resemble the Bryocorinae and differ from the remaining sub-families of Capsidae, in having no vesica.

Endosoma large, membranous except for a pair of thick patches in the proximal region; distally its junction with the ejaculatory duct marked by a distinct constriction. Ejaculatory duct short, narrow, having a spiral lining. Parameres as in Bryocorinae.

Sub-family *Cyllocorinae.*

Tribe *Cyllocoraria.*

Forms examined : *Pilophorus clavatus* L., *Cyllocoris flavoquadrimaculatus* De G., *Blepharidopterus angulatus* Fall., *Mecomma ambulans* Fall., *Cyrtorrhinus caricis* Fall., *Orthotylus virens* Fall., *O. marginalis* Reut., *O. ochrotrichus* Fieb., *O. diaphanus* Kbm., *O. flavosparsus* C. Sahlb., *Heterotoma meriopterum* Scop., *Heterocordylus leptocerus* Kbm., etc.

Cyllocoris flavoquadrimaculatus. (Pl. XV, fig. 105.)

Phallosoma much elongated, longer ventrally, uniformly wide, heavily chitinised, phallosoma-mouth large. Vesica much shorter than in Capsinae, narrow, cylindrical, gonopore at its distal extremity. A pair of strong and large vesica appendages present, protruding out of the phallosoma mouth, branched and dentated in the distal region. Left paramere very large, expanded and forked in the distal region, the right smaller, narrower and curved.

Mecomma ambulans. (Pl. XVI, fig. 106.)

Phallosoma elongated, less heavily chitinised. Vesica longer than in *Cyllocoris*, gonopore at its distal end; a pair of delicate conjunctiva appendages present. Parameres in their general form resembling those in the above form.

Orthotylus ochrotrichus. (Pl. XVI, fig. 107.)

Almost resembles *Cyllocoris*. Basal plates more heavily developed; phallosoma wider; the left paramere expanded in the distal region, but not forked, the right club-shaped.

Heterotoma meriopterum. (Pl. XVI, fig. 108.)

The vesica appendages slender, very much elongated, twisted, entangling each other. The left paramere slightly forked in the distal expanded region, the right better developed than in the above forms.

Tribe *Laboparia*.

Orthocephalus saltator Hhn. (Pl. XVI, fig. 109.)

Basal plates and phallosoma delicate, the latter fusiform. Vesica, unlike that in *Cyllocoraria*, longer than the ejaculatory duct within it, the gonopore in the middle of its length instead of at its apex. Vesica appendages small and delicate. The left paramere expanded in the middle, but not forked.

Strongylocoris leucocephalus L. (Pl. XVI, fig. 110.)

Phallosoma markedly narrow in the distal region; vesica long, gonopore near its apex, vesica appendages still delicate. The left paramere expanded and forked in the distal region.

Remarks on Laboparia.—The genitalia in *Orthocephalus* come quite close to those in some Miraria (Capsinae), while *Strongylocoris* comes nearer to *Mecomma* (fig. 106).

Sub-family *Plagiognathinae* (= *Phylina*, Reut.).

Forms examined: *Onychumenus decolor* Fall., *Conostethus salinus* J. Sahlb., *Macrotylus solitarius* Mey., *Megalocoleus pilosus* Schrk., *Harpocera thoracica* Fall., *Psallus betuleti* Fall., *Plagiognathus arbustorum* F.

Psallus betuleti. (Pl. XVI, fig. 111.)

Basal plates very well developed. Phallosoma very much elongated, narrow, bent in the middle, highly dechitinised except in the extreme distal region. Vesica very long, protruding out of the phallosoma mouth in the condition of repose, narrow, thin-walled, having a pair of conical appendages (probably corresponding to those in Cyllocorinae) in its distal region around the gonopore. Ejaculatory duct on entering the aedeagus, wide and thick-walled,

then narrowed but without a spiral lining, within the vesica again wide and thick-walled and hence very conspicuous. The left paramere very much flattened and expanded in its distal region, the right narrower and shorter.

General remarks on Capsidae.

The endosoma is differentiated into conjunctiva and vesica, except in the sub-families Bryocorinae and Dicyphinae, but this differentiation is entirely different from that in Pentatomidae, Lygaeidae, etc., where the vesica is a narrow, stiff, cylindrical organ, while in Capsidae it is bulbous, produced into diverticula, etc. In fact, the endosoma in Capsidae almost resembles that in Tingitidae, Reduviidae, etc., except that in its middle it is fused to the ejaculatory duct and thus is differentiated into two regions, the conjunctiva and vesica. The endosoma in Bryocorinae and Dicyphinae is totally undifferentiated, resembling that in Reduviidae, etc. Moreover, the ejaculatory reservoir invariably present in Pentatomidae, etc., and absent in Tingitidae and Reduviidae, is absent in Capsidae as well.

The position and classification of Capsidae have engaged the attention of numerous eminent Rhynchotists, and yet, of the several systems proposed, there is not one which can claim the acceptance of all. In this connection it is worth while recalling the words of Distant, who wrote : " At present the classification of the family is more reflective of personal opinion and contrived for the purpose of entomological arrangement, than exhibiting an evolutionary and philosophical conception. The Capsidae are a very difficult group to study, their affinities are of the most complicated description, and for the present we must be satisfied with somewhat artificial or cabinet arrangement."

According to Reuter, the Capsidae belong to his series Anonychia, which also includes Tingitidae, Reduviidae, Hebridae, Mesoveliidae, etc. In view of the remarks I made in connection with Hebridae, etc., the question whether his series Anonychia is a natural group will be discussed later on, but, as is evident from the above account of the genitalia, the family Capsidae is allied to Tingitidae and Reduviidae, though this alliance is a remote one.

As regards the division of the family into sub-families, the structure of the genitalia, while confirming in the

main the conclusions of Reuter, also indicates the relationships of the sub-families and thus fills in the gaps which Reuter's work had left.

The genitalia in the different sub-families whose representatives have been examined, can be reduced to two chief sub-types, one found in Bryocorinae and Dicyphinae, the other in Capsinae, Cyllocorinae and Plagiognathinae. In the different genera of Capsinae and Cyllocorinae, a series of gradation in the structure of the genitalia can be made out, the tribe Miraria of the Capsinae being very similar to the tribe Laboparia of the Cyllocorinae, while the Capsaria and the Cyllocoraria of the two respectively form the extremes of the series. The genitalia in the Plagiognathinae are a specialisation of those in the tribe Cyllocoraria of the Cyllocorinae.

It is worth while repeating that the genitalia in Cimicidae, etc. are a specialisation of the Bryocorine and Dicyphine type.

Series V. TRICHOTELOCERA.

Super-fam. *Ceratocomboideae.*

Family Ceratocombidae.

Forms examined: *Ceratocombus coleoptratus* Zett., *Cryptostemma alienum*, H. S.

Ceratocombus coleoptratus. (Pl. XVI, fig. 112.)

The posterior abdominal segments asymmetrical.

Basal plates slightly compressed, completely fused with each other, their region of fusion produced into a long prolongation (bp.pr). Phallosoma wide, fairly thick, especially thickened along the dorso-lateral margins, phallosoma mouth very large; endosoma undifferentiated into conjunctiva and vesica, short, thicker in the distal region and narrow. Parameres in actual contact with the dorsal ends of the basal plates (a feature rare amongst the Heteroptera), elongated, narrow in the distal region.

In *Cryptostemma* the parameres are asymmetrical.

Remarks.—The structure of the basal plates and their actual contact with the parameres are characteristic of the genitalia in Homoptera (vide infra), but the position of the plates, as bordering the basal foramen, is undoubtedly a strong Heteropterous character.

The position of Ceratocombidae is still sub judice—Saunders, Butler, Handlirsch, etc. put it as a sub-family of Cimicidae, Oshanin and Reuter created a distinct series, Trichotelocera, for it, and put this series between Anonychia and Hydrobiotica. In the structure of the genitalia there is no point of similarity between Ceratocombidae and Cimicidae. Of all the Heteropterous families, the Reduviidae comes nearest the present family in the form of the basal plates and of the phallosoma, but evidently the genitalia in Ceratocombidae are highly specialised in the structure of the basal plates, which assume the shape of a Y, and are in actual contact with the bases of the parameres, features common amongst the Homoptera, as above mentioned.

Series VI. HYDROBIOTICA.

Super-fam. *Gerroideae.*

Phal. *Hydrometriformes.*

Family Hydrometridae.

Hydrometra stagnorum L. (Pl. XVI, fig. 113.)

Basal plates thin and completely fused with each other. Phallosoma long and tough; endosoma long, its distal region telescoped into the proximal, but not differentiated into a conjunctiva and vesica comparable to those in Pentatomidae, Lygaeidae, etc. Endosoma with two pairs of thick patches, one behind the other, in the distal region. Ejaculatory duct thin, narrow, without a spiral lining. Parameres originating very close to the dorsal ends of the basal plates.

Remarks.—The genitalia in Hydrometridae are not so different from those in Gerridae, etc. as to warrant its being elevated to the rank of a distinct family; much less is it justifiable to raise it to a distinct phalanx, Hydrometriformes, as is done by Reuter and Oshanin.

Phal. *Gerriformes.*

Family Gerridae.

Forms examined: *Ptilomera laticaudata* Hardw., *Gerris costae* H. S., *G. femorata* Mayr., *G. cereventris* Sign., *G. najas* De G., *G. lacustris* L., *G.* sp., etc.

Gerris sp. (Pl. XVI, fig. 114.)

The tergal region of the IXth segment continuous with that of the Xth, the latter is much longer than the sternal region, so the anal opening is on the ventral surface.

Basal plates thin, extremely flattened in the ventral parts, completely fused with each other. Phallosoma cylindrical, thin in the proximal region. Endosoma differentiated into three regions (not comparable to conjunctiva, vesica, etc. of the series Polyneuria): the proximal lining the phallosoma in the condition of rest, membranous, smooth except for a short transverse thickening in the distal dorsal region, the middle region large, wide, having a pair of longitudinal thickenings (th^1) in the lateral regions, the third or the distal region extremely narrow, having a pair of closely apposed thickenings (th^2) in the mid-dorsal line; in the condition of rest the distal region is bent towards the aedeagus base, held by the middle region, whose ventral surface consequently is pushed up and comes close to the dorsal, the lateral thickenings (th^1) serving as hoops for this purpose. Ejaculatory duct narrow and membranous throughout. Parameres originating from quite close to the posterior lateral margins of the IXth segment, nodule-like.

Gerris cereventris. (Pl. XVI, fig. 115.)

The dorsal region of the middle portion of the endosoma very conspicuously chitinised and hood-shaped; the thickenings in the distal portion indistinct; parameres still minute.

Family Veliidae.

Velia currens F. (Pl. XVI, fig. 116.)

Genitalia similar to those in *Gerris gracilicornis*, except that the proximal region of the endosoma is quite smooth, the longitudinal thickenings in the middle region (th^2) very delicate, and the narrow distal region is not only bent cephalad, but bent caudad again. Parameres much larger.

Remarks.—Evidently the structure of the genitalia does not support the opinion that the Gerridae and Veliidae should be considered as distinct families.

Super-fam. *Acanthioideae.*

Phal. *Acanthiiformes.*

Family Acanthiidae (Saldidae).

Forms examined: *Salda* (= *Chiloxanthus*) *pilosus* Fall., *S. littoralis* L., *S. saltatoria*, etc.

Salda (= Chiloxanthus) pilosus. (Pl. XVII, fig. 117.)

Genitalia quite different from those in other families of the series Hydrobiotica. Basal plates touching, but not fused with each other. Aedeagus not only differentiated into phallosoma and endosoma, but the latter again differentiated into conjunctiva and vesica (cf. series Polyneuria).

Phallosoma large, wide and membranous in the proximal region, narrow and thick in the distal, the latter bent over the proximal. Conjunctiva with only a single pair of irregular thick patches. Vesica stiff, narrow, curved, in close contact with the ejaculatory duct inside. No ejaculatory reservoir. Parameres originating from the bottom of the deep genital chamber, elongated and pointed at the apices.

S. littoralis. (Pl. XVII, fig. 118.)

Resembles *S. pilosus* except that the conjunctiva is thickened throughout in its ventral region and the vesica, still narrow, is longer and thrown into several coils.

Remarks.—The genitalia in Saldidae in all respects resemble those in Aradidae (figs. 43 and 44), especially of forms like *Mezira*, but almost all the Rhynchotists put Saldidae with other aquatic Hemiptera. Hereafter it will be shown to what extent "Hydrobiotica" is a natural group. The family Saldidae undoubtedly is out of place when grouped with other aquatic families. Osborn, however, did put Saldidae near Aradidae, an arrangement supported by the structure of the genitalia, but his suggestion has remained unaccepted.

Family Velocipedidae.

Velocipeda aliena Dist. (Pl. XVII, fig. 119.)

Genitalia of a type quite distinct from that in Acanthiidae. Basal plates rod-like and completely fused. Phallosoma wider in the proximal two-thirds, extremely narrow distally, the latter region bent over the former. Endosoma undifferentiated into conjunctiva and vesica, long, folded in the form of a Z. Parameres short and flat.

Remarks.—The above genitalia remind us of those in Tingitidae (figs. 67–69).

Phal. *Aepophiliformes.*

Family Aepophilidae.

Aepophilus bonnairei Sign. (Pl. XVII, fig. 120.)

The genitalia are almost the same as in *Salda*, except that the conjunctiva bears several thick patches in the proximal region. Vesica is extremely narrow, hardly separable from the ejaculatory duct inside.

Remarks.—The position of Aepophilidae is still not decided. In the British catalogue it is treated as a sub-family of Hydrometridae or Gerridae, and most English authors, Butler, Distant, etc. have followed this arrangement. Oshanin put it along with Acanthiidae or Saldidae. The structure of the genitalia strongly points to the Saldid affinities of this family and thus definitely settles its position, and, moreover, suggests that the Acanthiidae and Aepophilidae are too similar to each other to be considered as distinct families.

Super-fam. *Notonectoideae.*

Phal. *Notonectiformes.*

Family Notonectidae.

Sub-family *Notonectinae.*

Notonecta sp. (Pl. XVII, fig. 121.)

Basal plates small, expanded, and completely fused with each other in the ventral region. Aedeagus differentiated into phallosoma and endosoma, the latter, however, not distinguished into conjunctiva and vesica. Phallosoma cylindrical and narrow in the proximal region, very wide in the distal, its mouth, however, extremely small, a pair of longitudinal thickenings present in the ventral region. Endosoma smooth, and imperceptibly continuous at its distal end with the narrow and delicate ejaculatory duct. Parameres small, pointed at the apices.

Anisops niveus F. (Pl. XVII, fig. 122.)

Unlike that in *Notonecta*, the sternal region of the IXth segment projects much in the posterior direction.

Phallosoma annulated proximally, very thin in the distal wider region, imperceptibly continuous with the endosoma, devoid of

any longitudinal thickenings. Gonopore more distinct than in *Notonecta*. Parameres asymmetrical, much expanded, leaf-like, the left much narrowed in the distal region.

Sub-family *Pleinae*.

Plea minutissima F. (Pl. XVII, fig. 123.)

Phallosoma uniformly thick, its mouth very wide. Endosoma with a few thick patches in the proximal region. Parameres almost asymmetrical, elongated, pointed at the apices.

Remarks.—The structure of the basal plates and the form of the phallosoma make the genitalia in Notonectidae distinct from those in any other family. As regards the two sub-families Notonectinae and Pleinae, two corresponding sub-types cannot be made out. *Anisops* differs as much from *Notonecta* as does *Plea*.

Phal. *Nepaeformes*.

Family Naucoridae.

Heleocoris minusculus Walk. (Pl. XVII, fig. 124.)

The ventral region of the IXth segment is curved up at the posterior margin, so the opening of the genital chamber, which is very small, points dorsally rather than towards the posterior. The aedeagus is sharply bent in its proximal region so as to point cephalad.

Basal plates completely fused with each other in the median ventral line, extraordinarily well developed and thickened at their dorsal ends. Phallosoma long, cylindrical, phallosoma mouth inclined towards the right. Endosoma membranous, comparatively thick in the distal region, so as to assume the form of a vesica. Parameres small, originating from near the posterior margin of the IXth segment.

Naucoris cimicoides L. (Pl. XVIII, fig. 125.)

Phallosoma annulated and thin in the proximal region, with a longitudinal thickening on the ventral wall. Parameres larger, flat, constricted in the middle, lying flat over the bent aedeagus and the IXth segment, pointing cephalad like the aedeagus, crossing and overlapping each other, the left over the right.

Remarks.—The above genitalia are characteristic of the family Naucoridae, and they come nearer to those in Notonectidae than to those in Nepidae or Belostomidae, along with which this family is put in the phalanx Nepaeformes.

Family Nepidae.

Laccotrephes maculatus F. (Pl. XXXII, fig. 126.)

The genitalia are extremely modified and complicated. The IXth segment is very much elongated, its ventral region projects both anteriorly and posteriorly beyond the lateral and the dorsal regions. The short Xth segment is continuous with the IXth, there being no differential chitinisation to limit their boundaries.

Aedeagus still more complicated. Basal plates rod-like, very long, deeply curved towards the posterior, completely fused with each other in the median ventral line, their point of junction continued into a pair of ligaments or struts (st), running as fine threads on the sides of the ejaculatory duct and ending at the base of the vesica. Phallosoma elongated with a large and oblique mouth, comparatively much larger dorsally, the proximal half of the dorsal region thin, while the distal is stiff and produced into a anterio-dorsally directed diverticulum (dv) which projects into the body cavity, through the basal plates, the membranous proximal region being also invaginated or pushed inside along with it, and covering it like a very thin film (made out only with staining). Therefore the basal plates which are at the usual place in the body wall, encircle the phallosoma in the middle of its length. Fig. 126*b* is made after pulling out the phallosoma, so as to bring it into a position corresponding to that prevalent in all other Heteroptera. It is highly improbable that the structure assumes this form even in copulation.

The endosoma may be said to be differentiated into conjunctiva and vesica. Conjunctiva very short, smooth, thin, imperceptibly continued into the thin-walled vesica; the junction of the two is not in contact with the ejaculatory duct within, so as to give rise to a distinct vesica comparable to that in Pentatomidae, etc. Vesica extremely narrow, thread-like, beginning from near the dorsal surface and lodged in the long phallosoma mouth, slightly projecting like a "tongue" beyond its distal end. Ejaculatory duct extremely narrow and fairly thick-walled; it follows the fate of phallosoma, *i.e.* after its entry into the aedeagus, it bends cephalad, runs on the floor of the invaginated phallosoma, bends, runs back, crosses the region of the basal plates, enters the vesica through which it runs as a hair-like but conspicuous duct. Parameres originating from near the posterior lateral margins of the IXth segment, long, rod-like, slightly compressed, hook-like at the apices.

Remarks.—Evidently the above type of genitalia is unique amongst Rhynchota.

Family Belostomidae.

Belostoma sp. (nr. **micrantula** Stal.) (Pl. XVIII. fig. 127.)

Basal plates slender, rod-like. Phallosoma elongated, wider in the distal region, shorter dorsally, so the phallosoma mouth very large and gaping, extending laterally. Endosoma very short, smooth. Parameres slender, curved, with pointed apices.

Belostoma anura H. S. (Pl. XVIII, fig. 128.)

Phallosoma much stronger and larger; parameres straight, slightly flattened, especially in the proximal region.

Remarks.—The above genitalia are characteristic of this family and have no close affinity with those in any other family of the super-family Notonectoideae.

Super-fam. *Ochteroideae.*

Family Mononychidae.

Mononyx grandicollis Germ. (Pl. XVIII, fig. 129.)

The posterior abdominal segments (beyond VIth) asymmetrical, *e.g.* VIIIth more developed in the right half, which extends towards the posterior, the left half of the posterior margin of the IXth produced into a spout-like process, the genital chamber turned towards the left instead of posteriorly.

Basal plates thin, compressed. Aedeagus undifferentiated into phallosoma and endosoma—a unique feature amongst Heteroptera, extremely elongated, narrow, curved upwards in the distal region, finely pointed at the apex. Gonopore a little before the distal extremity on the ventral side. Ejaculatory duct thin, narrow and inconspicuous. Parameres showing still greater degree of asymmetry, the left totally undeveloped, the right enormously enlarged, curved, with a groove to lodge the aedeagus in the state of rest (cf. Cimicidae, where the left paramere is enlarged and similarly modified and the right is not developed).

Family Ochteridae (Pelogonidae).

Pelogonus marginatus Latr. (Pl. XVIII, fig. 130.)

The genitalia are of the same type as in Mononychidae.

The abdominal segments show a smaller amount of asymmetry, *e.g.* the IXth segment is more developed in its left half, but not produced into a spout-like process. Basal plates smaller. Aedeagus extending as a hair-like process beyond the gonopore. Paramere without any groove, but with a pair of thick processes at the apex.

Series VII. SANDALIORRHYNCHA.

Super-fam. *Corixoideae.*

Family Corixidae.

Corixa sp. (Pl. XVIII, fig. 131.)

Posterior abdominal segments and the genitalia asymmetrical, inclined towards the side. The sternal region of the IXth segment produced into a long posteriorly-directed keel-like process, mistaken by some investigators (*e.g.* Poisson) for a part of the "penis."

Basal plates thin, flat, expanded and continuous with each other. Phallosoma large, fusiform, its mouth on the dorsal side in the distal region, not at the extremity. Endosoma differentiated into conjunctiva and vesica, comparable with those in Nepidae, but not with those in the series Polyneuria. Conjunctiva very long, projecting into the body cavity through the basal plates. Vesica extremely narrow, thread-like, long, protruding out of the phallosoma mouth, without any penetrative power, the pointed posterior end of the phallosoma and the keel-like IXth sternite being useful in this connection. Ejaculatory duct fairly distinct and affording a certain amount of stiffness to the vesica. Parameres asymmetrical, the left large, very much flattened, especially in the proximal region, and the right resembling a thin, narrow and twisted plate.

Micronecta sp. (Pl. XVIII, fig. 132.)

The IXth segment shows an even larger amount of asymmetry, but its sternal region is not produced into a keel-like process.

Phallosoma almost cylindrical, its mouth at the distal extremity; vesica shorter, stiff and more penetrative. Parameres asymmetrical, but almost of the same size.

Remarks. The Corixidae have a type of genitalia of their own, but it is not so greatly different from that in any of the previous family as to warrant the family Corixidae being placed in a separate series by itself.

Remarks on Heteroptera.

The Heteropterous genitalia are characterised by the following features :—

The basal plates are always in the body wall, surrounding the basal foramen. The aedeagus is often wide, large and differentiated into phallosoma and endosoma, the latter also in some families distinguished into conjunctiva

and vesica. The conjunctiva is often produced into diverticula or provided with a varying number of appendages, rarely the vesica also possesses this character, *e.g.* Capsidae. The ejaculatory duct is narrow and inconspicuous, but where the vesica is developed it is greatly modified in its course within this organ, being very thick and wide; moreover, it expands into the ejaculatory reservoir at the base of the vesica. The parameres are generally symmetrical, sometimes the right is different from the left, *e.g.* in Capsidae, Corixidae, etc., rarely one is altogether absent, *e.g.* right in Cimicidae, left in Mononychidae, etc. The parameres are connected to the basal plates by means of chitinous ligaments, but are not in actual contact with the same. Sometimes the genitalia as a whole lie asymmetrically, this asymmetry being often accompanied by a similar condition of the posterior abdominal segments.

The above type of genitalia is distinct from that in the next sub-order Homoptera, where the basal plates never surround the basal foramen, but lie on the inner surface, facing the body cavity, of the segmental membrane, the aedeagus is almost always (Fulgoroidea excepted) undifferentiated into phallosoma, conjunctiva, vesica, and the parameres are always symmetrical and in actual contact with the basal plates.

While the Heteroptera are distinct from the Homoptera, the different series (of Reuter and Oshanin) into which the various Heteropterous families are grouped are not distinct from one another in the structure of the genitalia. The first three Polyneuria, Phloeobiotica and Onychiophora, including the super-families Pentatomoideae, Coreoideae, Aradoideae, Lygaeoideae, have all one type of genitalia, and the next four Anonychia, Trichotelocera, Hydrobiotica (with the exception of the family Acanthiidae) and Sandaliorrhyncha, including all the rest of the families, another type. The first, which I will call Pentatomid type, is characterised by :—

Basal plates thin, flat, simply touching, not fused with each other in the mid-ventral line; aedeagus differentiated into distinct phallosoma, conjunctiva and vesica; ejaculatory reservoir present and the ejaculatory duct within the vesica thicker than in the phallosoma region; genital chamber well developed, its walls often thickened and ornamented and the inferior process present; parameres originating from the bottom of the genital chamber at

some distance from the posterior margin of the IXth segment.

In the other type, which I will term Reduviid type, the basal plates are rod-like, slightly compressed, and completely fused with each other; aedeagus differentiated only into phallosoma and endosoma (in *Pelogonus*, etc. almost totally undifferentiated); the ejaculatory duct narrow throughout, without any reservoir: genital chamber shallow, its walls smooth, the inferior process not developed, except in Tingitidae and Reduviidae; parameres originating from near the posterior margin of the IXth segment.

The families Saldidae and Aepophilidae of the Hydrobiotic series of the second group absolutely resemble the families of the first group.

In Mononychidae and Ochteridae the aedeagus is not differentiated into phallosoma and endosoma, a Homopterous feature, but in all the other characters the genitalia in these familes are of the Heteropterous type.

Thus the structure of the genitalia suggests that there can be only two groups into which the different families can be divided instead of seven (corresponding to the seven series of Reuter and Oshanin); the first three of these series and the families Acanthiidae and Aepophilidae forming one group, the remainder forming the other. Then, amongst these groups I have not been able to find sub-types for the individual series, *e.g.* in the first group the whole of the series Polyneuria (Pentatomidae, Coreidae, etc.) and the second series Phlocobiotica (Aradidae, etc.) and the Pyrrhocoridae of the third series Onychiophora have one sub-type, while the Lygaeidae of the Anonychia have another. In the second group, all the remaining four series, Anonychia (Tingitidae, Capsidae, Reduviidae), Trichotelocera (Ceratocombidae), Hydrobiotica and Sandaliorrhyncha (Corixidae), have one type, which cannot be reduced to any sub-types. Of course all the different families in these four series, as well as those in the first three, have distinct types of their own, except where otherwise stated in the text. Thus one is tempted to the conclusion that the " series " of Reuter are mostly artificial groups so far as the testimony of the structure of the genitalia goes.

It is important to point out that the above two groups *do not* correspond to the divisions " Gymnocerata " and " Cryptocerata " of Fieber.

As regards the question which of the above two types is primitive, one will not hesitate to say that the Reduviid type, in which the aedeagus is differentiated into phallosoma and endosoma only, the latter not being differentiated into conjunctiva and vesica, is more primitive from a morphological point of view; but by this it is not meant that the first families, having the Pentatomid type, originated from those having the Reduviid type. Amongst the latter there are families, like Nepidae and Corixidae, whose genitalia show a very high degree of specialisation. The state of asymmetry also is more commonly met with in the second group than in the first. Then all the families having the Pentatomid type (first group) have the basal plates which are distinct from, not fused with each other, a very primitive feature by itself.

(*b*) *HOMOPTERA.*

Series VIII. AUCHENORHYNCHA.

Super-fam. *Cicadoideae.*

Family Cicadidae.

The forms studied have been arranged into divisions and sub-families after Distant.

Sub-family *Cicadinae.*

Div. *Polyneuraria.*

Forms examined : *Platypleura stridula* L.; *P. westwoodi* Stål, *P. octoguttata* F., *Pycna semiclara* Germ.

Platypleura stridula. (Pl. XIX, fig. 133.)

The sternal region of the VIIIth abdominal segment very much produced posteriorly, forming a distinct "hypandrium." The IXth segment very large, its sternal region lying far forwards as compared with the tergal, so that its lateral regions (pygofers) which are very broad and conspicuous, are oblique in disposition. The Xth is small, its ventral region is comparatively much larger than the tergal, so that the anus is on the dorsal surface; moreover, this segment is lobed in its postero-ventral region, and has on the ventral surface a deep groove in which the aedeagus is lodged, and is held there in position by the lobes. Anus surrounded by two large

conical sclerites, one above, the other below it (anal styles), connected to each other by a pair of small ones in the lateral regions.

Aedeagus projects from near the sternal region of the IXth segment, the segmental membrane is smooth, membranous and is not pushed in cephalad to form a distinct genital chamber as is common in Heteroptera. Almost the whole of the aedeagus is exposed even in the ordinary conditions of life, only its extreme distal region being membranous and invaginable or endosomic; thus, unlike that in most Heteroptera, the aedeagus may be said to be undifferentiated into distinct phallosoma and endosoma. Ejaculatory duct thin, elastic, running straight through the aedeagus, surrounded, while entering the basal foramen, by an indefinite chitinous ring-like sclerite, fused to it, and most probably representing the vestiges of the basal-plates bridge. Basal plates lying on the inner surface (facing the body cavity) of the segmental membrane, very strong, compressed, meeting at the base of the aedeagus, forming a V-shaped structure, the point of their junction being slightly elongated and flattened. As will be noticed, the basal plates are not in the basal rims of the aedeagus, surrounding the basal foramen, as is the case in all Heteroptera. The homopterous condition can be derived from the heteropterous by imagining that the body wall, or the segmental membrane coming down from the dorsal surface of the body, instead of becoming continuous with the aedeagus at the free ends of the basal plates (as is the case in Heteroptera) does so at a point a little posterior to this region, *i.e.* the basal region of the aedeagus has become a part of the body cavity, or the basal foramen has shifted in the caudal direction, and consequently the plates lie on the segmental membrane, their free ends (dorsal in position in Heteroptera) coming nearer the ventral surface of the body (figs. 1 and 2).

Parameres absent in the family Cicadidae as a whole.

The subgenital plates present in almost all other Homoptera are not developed in Cicadidae.

The IXth segment has a pair of small conical diverticula in its ventro-posterior region (dv). Kershaw and Muir homologised these with the parameres, but the morphology of the two sets of structures does not support such a view (fully discussed in Section VII).

Platypleura octoguttata. (Pl. XIX, fig. 134.)

Almost similar to *P. stridula*. The Xth segment, however, different, its posterior ventral region being produced into only one pair of lobes and not two.

Div. *Cicadaria.*

Cicada pulverulenta Dist. (Pl. XIX, fig. 135.)

The genitalia are essentially of the same type as in *Platypleura*. Aedeagus, however, slender and comparatively narrower in the distal region. The structure of the Xth segment also different.

Rihana pontianaka. (Pl. XIX, fig. 136.)

Aedeagus very long and stout. Basal plates compressed, deeply curved, and with a large and flat region of junction. The diverticula in the posterior ventral region of the IXth segment very well developed.

Cryptotympana sp. (Pl. XIX, fig. 137.)

Aedeagus comparatively much larger, of almost uniform width, slightly wider at the distal end. The Xth segment produced into a long conical process in its posterior ventral region and not lobed.

Yanga seychellensis Dist. and a species of *Psaltoda* examined have the same type of genitalia as the above forms.

Div. *Dundubiaria.*

Dundubia mellea Dist. (Pl. XIX, fig. 138.)

Basal plates slender, narrow, rod-like, their region of junction dechitinised. Aedeagus comparatively shorter, sharply tapering in the distal region and pointed at the apex.

The lobes of the Xth segment hard and pointed at the apices.

D. vaginata F. (Pl. XIX, fig. 139.)

Closely resembles the above, but the lobes of the Xth segment blunt and broader.

Diceropyga obtecta. (Pl. XIX, fig. 140.)

Basal plates stronger and their region of junction moderately chitinised. Aedeagus strong, wider in the proximal region, narrow in the distal, expanded and lobed at the apex.

The lobes of the Xth segment very much elongated and chitinised.

Diceropyga opercularis Walk.

Differs from the above species only in the structure of the lobes of the Xth segment.

Cosmopsaltria guttigera Dist. (Pl. XIX, fig. 141.)

Basal plates small and delicate, with a large region of fusion which is moderately chitinised. Aedeagus wider in proximal region, narrower and tapering in the distal, but not whip-like, as it is in *Dundubia*.

The Xth segment has two unequal pairs of lobes in the posterior ventral region.

C. montivaga Dist. (Pl. XIX, fig. 142.)

Aedeagus more finely pointed in the distal region. The important difference, however, is in the structure of the lobes of the Xth segment: there are two distinct pairs, one much longer than the other.

C. agatha Moult.

The genitalia are identical with those in *C. montivaga*; both seem to be the same species.

Platylomia spinosa F. (Pl. XIX, fig. 143.)

Basal plates slender, long, their region of junction more chitinised than in *Cosmopsaltria*. Aedeagus narrower in the distal region, finely pointed at the apex.

The posterior ventral region of the Xth segment bilobed, with the apices of the lobes curving outwards.

Platylomia comes nearer *Dundubia* than do *Cosmopsaltria* or *Diceropyga*.

Pomponia sp. (Pl. XX, fig. 144.)

Basal plates slender, longer, with a small region of fusion. Aedeagus very long, tapering in the distal reigon.

The Xth segment has two pairs of long lobes, the dorsal pair is extraordinarily elongated.

Meimuna tripurasura Dist. (Pl. XX, fig. 145.)

Resembles *Pomponia* in essentials, the lobes of the Xth segment, however, smaller, but larger than those in any other genus of the division Dundubiaria.

Remarks on Cicadinae.—Genera representing Distant's three divisions of this sub-family have been examined; while the division Dundubiaria has a type of genitalia of its own, this cannot be said of the other two, Platypleura and Cicadaria: the structure of the genitalia warrants their amalgamation.

Sub-family *Gaeaninae.*

Div. *Cicadatraria.*

Khimbya evanescens Walk. (Pl. XX, fig. 146.)

The lobes of the Xth segment point towards the ventral side. Basal plates slender, elongated, their region of junction highly membranous. Aedeagus wider in the proximal region, tapering and extremely narrow in the distal.

Remarks.—The slender and isolated basal plates and the form of the aedeagus are almost similar to those in Dundubiaria.

Div. *Gaeanaria.*

Gaeana maculata Drury. (Pl. XX, fig. 147.)

Basal plates fairly stout, meeting each other quite close to the base of the aedeagus, therefore without a conspicuous, flattened and large region of junction. Aedeagus long, curved, distally continued into a very long, comparatively thin, strap-like portion which may represent the endosoma; the proximal region of the latter thin and covered with small spines, and with a conical appendage near the base. The "endosomic" region coiled like a flat spiral, the upper edge of the spiral being dentated.

Balinta octonotata Westw. (Pl. XX, fig. 148.)

Aedeagus without a strap-like distal part, fairly wide and flattened at the distal extremity, the latter with a stout appendage (sp) projecting towards the aedeagus base.

Div. *Fidicinaria.*

Fidicina opalina Germ. (Pl. XX, fig. 149.)

Basal plates flattened and completely fused with each other throughout their length, forming a thick platform at the base of the aedeagus. Aedeagus extremely stout, thick, long, wider and lobed at the distal end. Ejaculatory duct thick and smooth in the proximal region, rough and covered with small spines in the distal, the latter probably corresponding to the endosomic part in forms like *Gaeana.*

Div. *Moganniaria.*

Mogannia effecta Dist. (Pl. XX, fig. 150.)

The diverticula of the posterior ventral region of the IXth segment pointed and near the sternum; another pair of appendages (sp) present in the posterior dorsal region of the pygofers.

Basal plates as separate structures not present, but a flat and hard platform-like structure at the base of the aedeagus, probably corresponding to the two plates fused throughout (cf. Fidicinaria). Aedeagus short and narrow, slightly curved, expanded and divided into several spine-like and finely pointed lobes at the distal end.

Remarks on Gaeaninae.—The division Cicadatraria excepted, the sub-family has a form of genitalia distinct from that in the previous sub-family. However, the different divisions into which the several genera are arranged by Distant, as they stand, have not individually any sub-types of their own, though the different genera themselves differ from one another in the structure of the aedeagus.

Sub-family *Tibicinae.*

Div. *Huechysaria.*

Huechys sanguinea De Geer. (Pl. XX, fig. 151.)

Pygofers fairly large; the tenth segment with two pairs of lobes, the dorsal pair small and blunt, the ventral very much developed, hard and pointed at the apices, the aedeagus protruding from between the components of the latter pair.

Basal plates absent, the segmental membrane, however, much thickened at the base of the aedeagus, the thickening probably representing the vestiges of the region of fusion of the plates. Aedeagus short, wider in the proximal region, tapering in the distal, deeply divided at the distal end into three lobes, two lateral and one median ventral, the latter having the gonopore at its apex. Ejaculatory duct extremely thin.

Div. *Carinetaria.*

Carineta formosa Germ. (Pl. XX, fig. 150.)

The pygofers with two pairs of appendages in the postero-lateral regions, the ventral pair more developed and indented at the extremities. A fairly well-developed, platform-like sclerite at the base of the aedeagus representing the basal plates; ejaculatory duct fused to the above platform. Aedeagus curved and wide; there seems to be present a short endosomic part as well.

Div. *Tibicinaria.*

Tibicina haematodes Scop. (Pl. XX, fig. 153.)

The Xth segment extremely large and very much produced posteriorly, but not lobed. Distinct basal plates not present, but,

as in the above divisions, the segmental membrane heavily chitinised at the aedeagus base. Aedeagus enormously elongated, deeply curved and trilobed at the distal end, the median lobe long and carrying the gonopore.

Div. *Taphuraria.*

Abricta curvicosta Germ. (Pl. XX, fig. 154.)

Aedeagus short, wide, curved, slightly lobed at the distal end; a short endosomic region present as well; the latter covered with minute spines and tubercles.

Div. *Melampsaltaria.*

Melampsalta germaini. (Pl. XX, fig. 155.)

The Xth segment with only one pair of lobes, the latter hard and finely pointed.

Segmental membrane slightly more thickened over a small area at the aedeagus base. Aedeagus highly specialised, divided almost throughout its length into three lobes; the median lobe carrying the gonopore, comparatively small and conical, the other two extremely long.

Remarks on Tibicinae.—In the five divisions into which the Tibicinae are arranged, there are only two distinct types of genitalia :—The Carinetaria and Taphuraria have almost similar genitalia approaching the Gaeanine type, while the other three, Huechysaria, Tibicinaria and Melampsaltaria, have a type distinct from that in the sub-families Gaeaninae or Cicadinae.

Remarks on Cicadidae.

The essential plan of the genitalia is the one prevailing in Membracidae, Cercopidae and Jassidae, the Cicadidae differing from them in the absence of distinct parameres and of the sub-genital plates. In the structure of the VIIIth segment and the absence of the sub-genital plates, the Cicadidae, of all Homoptera, come nearer Heteroptera; the sub-genital plates are absent in the Fulgoroideae and Psyllidae also (vide infra). In the absence of both the parameres and the sub-genital plates, this family is similar to the Coccidae.

Within the family, the genitalia in the different genera examined can be reduced to two types, one of which may be said to include two sub-types, but the three sub-familes have not individually distinct types of their own, as already shown in their respective account and as is evident from the following table :—

Sub-family.	*Div.*		
1. Cicadinae.	Polyneuraria. Cicadaria. Dundubiaria.	A^{I}. Basal plates large and distinct. Aedeagus large and comparatively narrow. No endosomic region.	A. Basal plates present. Aedeagus large and complete, not lobed.
2. Gaeaninae.	Cicadatraria.		
3 Tibicinae.	Gaeanaria. Moganniaria. Fidicinaria. Carinetaria. Taphuraria.	A^{II}. Basal plates stouter, but often more or less fused with each other, aedeagus shorter and wider and sometimes with distal endosomic region.	
	Huechysaria. Tibicinaria. Melampsaltaria.	. . . .	B. Basal plates absent, except that their region of fusion is represented by a greater thickening of the segmental membrane at the aedeagus base. Aedeagus small, divided into three lobes.

Of the above types B seems to be more specialised than A, similarly A^{I} appears to be more primitive than A^{II}.

Every genus has a characteristic aedeagus, which, however, does not afford good specific characters; species can only be separated on the basis of the structure of the Xth segment, vide *Platypleura*, *Dundubia*, *Cosmopsaltria*, etc.

Family Membracidae.

Sub-family *Membracinae.*

Oxyrhachis sp. (Pl. XXI, fig. 156.)

Ninth segment large, especially in the lateral regions (pygofers), its sternal region comparatively small and bearing a pair of appendages at its posterior margin, the sub-genital plates; the latter very large, continuous with and of the same consistency as the sternite, segmental membrane extending up to their distal extremities. Tenth segment small and ring-like. Sclerites round the anus small; the anal style hanging down.

Aedeagus projecting from near the sternal region, bent at the base so as to point in the dorsal direction, undifferentiated into phallosoma and endosoma, wider in the proximal region, tapering in the distal and pointed at the apex; gonopore on the ventral side a little before the apex. Ejaculatory duct delicate and membranous. Basal plates small, delicate, fused with each other to form a single thin flat piece. Parameres lying lateral to and a little below the level of the aedeagus; their proximal ends projecting into the body cavity for some distance and in contact with the basal plates, a condition constant in Homoptera.

The segmental membrane above the base of the aedeagus thickened in its lateral regions into two large plates, one on each side (sh), covering and protecting the aedeagus like a pair of sheaths.

Sub-family *Centrotinae.*

Forms examined : *Telingana* sp., *Leptocentrus* sp., *Centrotus cornutus* L., *Gargara* sp., etc.

Leptocentrus sp. (Pl. XXI, fig. 157.)

The genitalia of the same type as in *Oxyrhachis.* Aedeagus with a row of small teeth-like spines in distal dorsal region. Basal plates forming a depressed plate, which is comparatively narrower near the basal foramen. Parameres very well developed, slightly curved and greatly flattened at the apices. Sub-genital plates very well developed, nodule-like at the apices. The thickenings in the lateral regions of the segmental membrane very large.

Gargara sp. (Pl. XXI, fig. 158.)

Aedeagus narrower and elongated in the distal region. Parameres broad in the proximal region, narrower in the distal, flattened at the apices. Sub-genital plates thin, flat and triangular. The thickenings in the lateral regions of segmental membrane small.

Sub-family *Hoplophorinae.*

Umbonia orozimbo Fairm. (Pl. XXI, fig. 159.)

Aedeagus slightly bent at the base, so as to point backwards; basal plates extremely reduced, represented only by a small flat chitinous piece at the aedeagus base. Parameres smaller, flattened, narrow in the middle. Sub-genital plates thin, flat and triangular. Segmental membrane not thickened in its lateral regions.

Sub-family *Aethalioninae.*

Aethalion reticulatum L. (Pl. XXI, fig. 160.)

Differs in several respects from the previous sub-families. Aedeagus turned dorsally, and fairly wide throughout its length. Parameres very small, broad in the proximal region, narrow and curved (hook-shaped) in the distal. Sub-genital plates of uniform width throughout. Segmental membrane not thickened in the lateral regions.

Remarks.—In the form of the aedeagus the above genitalia remind us of those in some Jassids. In this connection it is interesting to mention that Ashmead (Ent. Americana, v. p. 125, 1889) put the sub-family Aethalioninae with the Bythoscopidae (Jassidae). Stal, however, placed this amongst the Membracidae, a course accepted by most Rhynchotists, but not supported by the structure of the genitalia.

Darthula hardwicki Gray. (Pl. XXI, fig. 161.)

Genitalia specialised in several respects.

Posterior dorsal regions of the pygofers are enormously produced posteriorly into two large hairy processes, which come together and form a tail-like organ, resembling the siphon of Nepidae, which, however, is formed by the prolonged VIIIth pleurites.

Aedeagus thick, stout, with a broad base, the basal foramen being elongated vertically, wide, rounded and blunt at the apex. Gonopore large and elliptical. Basal plates forming an extremely well-developed thick sclerite near the aedeagus base. Parameres stout, broad and flattened especially at the apices. The sub-genital plates are extremely small, lobe-like, absolutely continuous with the IXth sternite, hardly distinct from it.

Remarks.—The natural position of this genus is still unsettled. Distant put it in the Membracidae, but apart

from any of the sub-families. The form of the aedeagus brings it nearest to *Aethalion* of all other Membracid genera examined; however, the parameres in the two are quite different, so that their affinities seem to be rather remote; *Darthula* looks more specialised.

Remarks on Membracidae.

In essential plan the above genitalia are the same as in Cercopidae and Jassidae (vide infra) coming near those in the latter. In the continuity of the sub-genital plates with the IXth sternite, Membracid genitalia are more primitive, while their basal plates show a high specialisation.

Family Cercopidae.

Sub-family *Cercopinae.*

Forms examined: *Eoscarta borealis* Dist., *Tomaspis* sp., *T. rubra* L., *Locris neavei* Lallemand (*nec* Distant), *Phymatostetha stellata* Guer., *Cosmoscarta* (*Suracata*) *basinotata* Butl., *Triecphora vulnerata* Illig.

Eoscarta borealis. (Pl. XXI, fig. 162.)

Ninth segment large, comparatively shorter in the dorsal region. The proximal sclerites round the anus in the form of a complete ring, the distal ones fairly large, the conspicuous anal style attached to the lateral regions of the latter.

Aedeagus originating from near the sternal region, the segmental membrane around its base heavily chitinised and bulging caudad in the form of a bulb—the periandrium, the aedaegus appearing to project from the centre of the apex of the bulb. Aedeagus almost undifferentiated into phallosoma and endosoma, the extreme distal region sometimes membranous and invaginable, therefore endosomic; aedeagus long, cylindrical, bent near the base, the distal region pointing cephalad; gonopore near the distal extremity on the ventral side. Basal plates specialised by total reduction—the periandrium giving the necessary support to the aedeagus instead. The lateral regions of the periandrium, the virtual position of the basal plates in other Homoptera, comparatively more thickened and in contact with the bases of the parameres.

Parameres stout, flattened, bearing short ridges along the dorsal margin. Sub-genital plates distinct from the IXth sternite, leaf-like, finely pointed at the apices.

Tomaspis sp. (Pl. XXI, fig. 163.)

The posterior margins of the pygofers bear a pair of conical processes (pgr. sp). Aedeagus short and narrow, slightly curved. Parameres elongated, flattened in the proximal region and blunt at the apices. Sub-genital plates broad, continuous with the IXth sternite.

Tomaspis rubra. (Pl. XXI, fig. 164.)

Differs from the above species in several respects. The posterior margins of the pygofers bear two pairs of large processes. Aedeagus comparatively wider in the middle. Parameres plate-like in the proximal two-thirds, narrow, curved and twisted in the distal region. Sub-genital plates enormously elongated, triangular, *two-segmented*, a unique feature, the distal segment smaller and separated by a fine suture from the proximal.

Locris neavei. (Pl. XXI, fig. 165.)

Almost similar to *Eoscarta*.

Aedeagus very much elongated, pointing towards the head end; its distal region for some length membranous and invaginable. Periandrium truncated at the distal extremity. Parameres bearing ridges on the margins. Sub-genital plates slightly different from those in *Eoscarta*—rigid, plate-like proximally, extremely narrow in the distal region.

Phymatostetha stellata. (Pl. XXII, fig. 166.)

Genitalia almost similar to those in *Tomaspis* sp. (fig. 163). Sub-genital plates, however, extraordinarily well developed.

Cosmoscarta (Suracata) basinotata. (Pl. XXII, fig. 167.)

Aedeagus long, straight, with two pairs of processes (sp), unequal in size, at the distal end, the proximal pair pointing in the anterior direction, the distal in the posterior. Periandrium large but not heavily chitinised. Parameres flattened in the proximal region, very narrow in the distal. Sub-genital plates continuous with the IXth sternite.

Remarks.—In essential plan *Cosmoscarta* resembles *Tomaspis* and *Phymatostetha*.

Triecphora vulnerata. (Pl. XXII, fig. 168.)

Same plan as that in *Eoscarta*.

Aedeagus bearing two unequal pairs of very long and fine spines at the apex. Periandrium very large. Parameres short and flattened.

Remarks on Cercopinae.—The different genera studied fall into two groups :—(i) *Eoscarta*, *Locris* and *Triecphora*—Aedeagus very much elongated; parameres leaf-like; sub-genital plates distinct from the IXth sternite; pygofers without any processes. (ii) *Tomaspis*, *Cosmoscarta* and *Phymatostetha*—Aedeagus small and straight; parameres flattened in the proximal region, narrow in the distal; sub-genital plates continuous with the IXth sternite; pygofers bearing conical processes on the posterior margins.

Sub-family *Aphrophorinae*.

Forms examined : *Ptyelus mahei* Dist., *Philaenus spumarius* L., *Clovia puncta* Walk., *Aphrophora maculata* Edw., *A. alni* Fall., *Jembrana ornata* Dist., *Sepullia* sp., etc.

Philaenus spumarius. (Pl. XXII, fig. 169.)

Pygofers produced posteriorly beyond the tergal or the sternal region.

Aedeagus straight, rod-like, pointing in the dorsal direction, with three pairs of fine spines at the apex. Parameres elongated, curved, flattened in the proximal region, their narrow bases projecting well inside the body cavity. Sub-genital plates thin, and continuous with the IXth sternite.

Ptyelus mahei. (Pl. XXII, fig. 170.)

Aedeagus narrow, without any hook or spine at the apex. Periandrium heavily chitinised, especially in the lateral regions. Parameres short, flat, depressed, boat-like, fused at their bases to the lateral regions of the periandrium. Sub-genital plates appear as triangular prolongations of the IXth sternite.

Clovia puncta. (Pl. XXII, fig. 171.)

Adeagus is similar to that in the above forms, it gives out a short process near the apex, which bears a pair of short hooks. Periandrium small and conical. Parameres bilobed at the apices.

Aphrophora alni. (Pl. XXII, fig. 172.)

Aedeagus extremely narrow and straight. Parameres leaf-like. Sub-genital plates very short and broad.

A. maculata. (Pl. XXII, fig. 173.)

Aedeagus much shorter than in the above species and slightly narrower in the middle of its length. Parameres of characteristic outline. Sub-genital plates slightly longer.

Jembrana ornata. (Pl. XXII, fig. 174.)

This form closely resembles *A. maculata*, differing only in the outline of the parameres.

J. ornata is one of the three new species of Distant's new genus *Jembrana*, described in the "Fauna of British India" (Vol. iv, p. 104). *J. ornata* appears to be a species of the genus *Aphrophora*.

Sepullia sp. (Pl. XXII, fig. 175.)

This form is specialised in several respects.

Aedeagus extremely short, appearing as an appendage at the apex of the periandrium. Parameres slender, elongated, projecting inside the body cavity for the most part of their length, their hook-like apices only being visible. Sub-genital plates reduced to extinction.

The segmental membrane between the aedeagus and the anal segment has a pair of small hairy blunt appendages (sm.app), one on each side—this feature has not been met with in any other Cercopid examined.

Sub-family *Machaerotinae*.

Machaerota ensifera Burm. (Pl. XXII, fig. 176.)

The sclerites round the anus small, the anal style large, thus much different from those in the previous sub-families. Aedeagus wide, fairly long, slightly curved, rounded at the apex. Periandrium slightly developed, being only heavily chitinised in the lateral regions. Parameres short, narrow, slender, slightly expanded in the distal regions. Sub-genital plates thin, flat, continuous with the IXth sternite.

Remarks.—In the incomplete development of the periandrium, the structure and form of the anal segment and of the anal styles, and in the form of the parameres, *Machaerota* comes near Jassidae and Membracidae.

Moonia variabilis. (Pl. XXIII, fig. 181.)

Pygofers much produced posteriorly in the dorsal regions. Tenth segment small; sclerites round the anus in the form of a ring. Anal style short, broad and distinct.

Basal plates small, rod-like, their prolongation short. Aedeagus very wide proximally, narrow in the distal region; the basal strut (st) well developed. Parameres very much elongated. Sub-genital plates large and broad, distinct from the IXth sternite.

Idiocerus atkinsoni. (Pl. XXIII, fig. 182.)

Pygofers large; sclerites round the anus small; anal style distinct. Basal plates short, fused with each other at an obtuse angle, their prolongation well developed. Basal foramen enormously elongated in the vertical plane. Aedeagus setiform. Basal strut slightly developed. Parameres with small platform-like outgrowths on the mesial faces in their proximal regions, where they come in contact with the basal plates, bearing a number of small teeth-like spines in the distal regions. Sub-genital plates elongated, hairy, distinct from the IXth sternite.

I. clypealis. (Pl. XXIII, fig. 183.)

Basal plates with their prolongation forming a T-like structure, the prolongation slightly asymmetrical. Basal foramen small, the basal strut well developed. Aedeagus' apex ornamented with two pairs of long spines (sp), unequal in length. Parameres stout, without any spines, etc.

I. scotti. (Pl. XXIII, fig. 184.)

Basal plates with their prolongation approach T in shape even more than in the above species. Aedeagus without any spines, the basal strut slightly developed. Parameres long, flattened a little before the middle. Sub-genital plates short and leaf-like.

I. populi. (Pl. XXIII, fig. 185.)

Basal-plates prolongation notched at the distal extremity, at the base of the aedeagus; the basal strut extraordinarily well developed; aedeagus with a pair of small spines at the apex. Parameres bearing four spines (unequal in size) in the distal region.

I. confusus. (Pl. XXIV, fig. 186.)

The genitalia are almost identical with those in *I. populi* except that there are two spines instead of four on the

parameres. It is highly doubtful whether these two forms deserve to be treated as separate species.

I. cognatus. (Pl. XXIV, fig. 187.)

The genitalia come near those in *I. populi*, the basal strut is longer and only slightly flattened in the dorsal region. The spines at the apex of the aedeagus are smaller. The parameres are devoid of any spines.

I. vitreus. (Pl. XXIV, fig. 188.)

The genitalia almost identical with those in *I. cognatus*.

I. scurra. (Pl. XXIV, fig. 189.)

The basal plates' prolongation deeply notched at its distal extremity; the basal strut short and stout; aedeagus with two unequal pairs of spines at the apex.

Oncopsis flavicollis. (Pl. XXIV, fig. 190.)

Basal plates rod-like, forming a Y-shaped structure. Basal foramen very large and wide, aedeagus short and narrow beyond its base, rod-like in the distal region. Unlike in all the above forms, there are here two basal struts which are, moreover, very much complicated and bear secondary processes and spines. Parameres long, stout, curved and hook-like in the proximal regions, flat and straight in the distal.

Nehela aterrima. (Pl. XXIV, fig. 191.)

Basal plates U-shaped. Aedeagus short. No well-differentiated basal strut. Parameres flat, especially in the distal region, where they are notched or bilobed. Sub-genital plates narrower in the distal region, the sutures separating them from the sternite very indistinct.

Remarks.—The above genitalia remind us of those in *Megophthalmus*.

Ipo conferta. (Pl. XXIV, fig. 192.)

Proximal sclerites round the anus in the form of a complete ring; anal style small.

Basal plates very small, their prolongation, however, fairly long; aedeagus of almost uniform width, with two spines, unequal in length, at the apex; gonopore at the distal extremity, not on the ventral side. Parameres stout and long. Sub-genital plates very much expanded, indistinctly separated from the sternite.

Eurinoscopus pelias. (Pl. XXIV, fig. 193.)

Differs in several respects from the previous forms of the sub-family Bythoscopinae.

Pygofers enormously produced in the posterior direction and with spine-like processes on the ventral margins. Anal style very long. Basal plates rod-like, their prolongation greatly lengthened. Parameres flat, curved and twisted proximally, straight otherwise. Sub-genital plates thin, long, and almost continuous with the IXth sternite.

Remarks.—This form resembles members of the next sub-family Tettigoniellinae in the presence of pygofer-spines, the general form of the pygofers themselves, the long anal style, long basal-plates' prolongation, continuity of the sub-genital plates with the IXth sternite, etc.

Eurymela distincta. (Pl. XXIV, fig. 194.)

Basal plates small, fused with each other, forming a transverse plate connecting the two parameres. Segmental membrane round the base of the aedeagus highly chitinised (cf. Cercopidae). Aedeagus very stout, fairly wide, especially in the proximal region, with a stout dorsal outgrowth from the base; the latter free of the segmental membrane and therefore not corresponding to the basal strut in the above forms. Parameres long and stout. Sub-genital plates very large, leaf-like, bearing each a style-like process (sty) in the distal region.

Remarks.—The reduction of the basal plates, thickening of the body wall round the aedeagus base, the fairly wide aedeagus, flap-like sub-genital plates, etc., remind us of the genitalia in Cercopidae. However, the presence of basal plates, though in a rudimentary condition, and the absence of a distinct periandrium, decide its relations with the Jassidae.

Sub-family *Tettigoniellinae.*

Forms examined: *Tettigoniella* sp. *ferruginea* F. group, *T. spectra* Dist., *T. viridis* L., *Bhandara sarawakensis* Dist., *Cyrtodisca major* Sign., *Euacanthus interruptus* L., etc.

Tettigoniella sp. **ferruginea** group. (Pl. XXIV, fig. 195.)

Pygofers enormously produced in the posterior direction and bearing spine-like appendages (pgr.app) on the ventral borders. Tenth

segment very long; the sclerites round the anus small; the anal style much elongated.

Basal plates short, fused with each other for almost half of their length, with a short and flat prolongation. Aedeagus wide, of almost uniform diameter, comparatively short. The segmental membrane above the aedeagus base slightly more chitinised, but without any definite strut like that in the Bythoscopinae. Parameres elongated, rod-like and narrow. Sub-genital plates triangular, of the same consistency as the IXth sternite but almost distinct from it.

T. spectra. (Pl. XXIV, fig. 196.)

Basal plates slender and their prolongation much longer. Parameres very small, slightly flattened, hard and pointed at the apices.

T. viridis. (Pl. XXIV, fig. 197.)

Basal plates' prolongation extremely elongated. Aedeagus different from that in the above two species: much wider in the proximal region, where it gives out a pair of flaps, which are as long and point in the same direction as the aedeagus (aed. fl); the basal strut is fairly differentiated. Parameres are of the same form as in *T. spectra*, their bases projecting, as long apophyses, inside the body cavity.

Bhandara sarawakensis. (Pl. XXV, fig. 198.)

The genitalia are almost similar to those in *T. viridis*. The outgrowths from the proximal region of the aedeagus are spine-like rather than flap-like. Parameres narrow in the distal halves.

Remarks.—*Bhandara*, a new genus described by Distant ("Fauna Brit. India," Rhynch., vol. iv, p. 221), seems hardly to be distinct from *Tettigoniella*. The structure of the genitalia supports the opinion of Walker, who described the present *Bhandara semiclara* (Sign) as *Tettigonia* (*Tettigoniella*) *sanguiflua* (List. Hom. Suppl., 1858, p. 222).

Euacanthus interruptus. (Pl. XXV, fig. 199.)

The pygofer appendages differ in form from those in *Tettigoniella*.

Basal plates very small, but their prolongation very long. Aedeagus much wider in the proximal region, narrow in the distal, where it bears a pair of spines. Parameres short, narrow and curved in the distal region. Sub-genital plates different from those in any of the above forms.

Cyrtodisca major. (Pl. XXV, fig. 200.)

Pygofers enormously produced in the posterior direction.

Both the basal plates and their prolongation short. Basal foramen very large, aedeagus wide, heavily chitinised and narrow at the apex. Parameres short, thick, flattened, narrow and elongated in the proximal region.

Sub-family *Gyponinae.*

Vulturnus vaedulcis Kirk. (Pl. XXV, fig. 201.)

Pygofers much produced posteriorly, as in Tettigoniellinae. Tenth segment ring-like and small; sclerites round the anus small; anal style long.

Basal plates short and rod-like, their prolongation not elongated. Aedeagus wider in the proximal region, narrow and spine-like in the distal; basal strut slightly developed. Parameres flattened in the proximal halves, narrow and curved in the distal, pointed at the apices. Sub-genital plates triangular in outline, distinct from the IXth sternite.

Gypona sp. (Pl. XXV, fig. 202.)

Basal plates meeting each other at an obtuse angle, their prolongation short. Aedeagus sharply bent in the proximal region, and greatly narrowed in the distal half. Parameres elongated, slightly flattened in the proximal region. Sub-genital plates large, triangular in outline, distinct from the IXth sternite.

Sub-family *Jassinae.*

Forms examined: *Jassus modestus* Scott, *Athysanus obsoletus* Kbm., *A. sordidus* Zett., *Balclutha chersonesia* Dist., *Scaphoideus vagans* Dist., *Deltocephalus ocellaris* Fall., *Limotettix stactogalus* Am., *Tharra nausikaa* Kirk., *Dorycephalus subreticulatus* Kirk., etc.

Jassus modestus. (Pl. XXV, fig. 203.)

Pygofers not so much produced in the posterior direction. Tenth segment short; the proximal sclerites round the anus in the form of a complete ring, the latter wider in the ventral region, the distal sclerites also well marked; anal style short but wide.

Basal plates slender, long, meeting each other at an acute angle, their prolongation long and thin. Basal foramen large, aedeagus wider in the proximal half, narrow and spine-like in the distal. Parameres very much flattened and almost triangular in outline in the proximal halves, narrow and rod-like in the distal, and pointed at the apices.

Sub-genital plates of the type common in Tettigoniellinae; triangular, bearing stiff hairs on the outer borders, of the same consistency as but distinct from the IXth sternite.

Athysanus obsoletus. (Pl. XXV, fig. 204.)

The Xth segment slightly longer than in *Jassus*; the sclerites round the anus and the anal style especially well developed.

Basal plates stout, curved, their prolongation very much flattened, notched and bilobed at the distal extremity. Aedeagus slightly thin in the median dorsal and ventral lines. Parameres much stouter, especially in the distal regions.

Athysanus sordidus. (Pl. XXV, fig. 205.)

The basal-plates prolongation shorter than in the above species, and the distal regions of the parameres not so much flattened. Sub-genital plates shorter and broader.

Balclutha chersonesia. (Pl. XXV, fig. 206.)

Basal plates long, curved, meeting each other at an acute angle, with a very long prolongation. Aedeagus short.

Scaphoideus vagans. (Pl. XXV, fig. 207.)

Pygofers large, very greatly prolonged in the posterior direction.

Basal plates rod-like, with an extremely long prolongation. Parameres very much flattened, very narrow and short in the distal region.

Deltocephalus ocellaris. (Pl. XXV, fig. 208.)

The genitalia come quite near to those in *Athysanus*.

Basal plates much elongated, their prolongation short but flattened. Parameres short. Sub-genital plates elongated.

Tharra nausikaa. (Pl. XXV, fig. 209.)

Pygofers small, but produced posteriorly into spine-like processes.

Basal plates as well as their prolongation short. Aedeagus with a spine-like process from near its base. Parameres slightly compressed in the proximal halves, rounded and curved in the distal, and pointed at the apices. Sub-genital plates large, very much expanded in the distal region.

Remarks.—Van Duzee put this genus amongst the Jassinae, Kirkaldy included it along with several other forms in a separate tribe *Jassini*, distinct from the rest of Jassinae or his Phrynomorphini. The genitalia, while

resembling those in Jassinae in essential plan, differ from them in several respects : (i) short basal plates, (ii) small pygofers, (iii) the form of the sub-genital plates, (iv) parameres not much flattened in the proximal regions. Thus the structure of the genitalia supports Kirkaldy's arrangement.

The basal plates and sub-genital plates remind us of those in Bythoscopinae.

Dorycephalus subreticulatus. (Pl. XXV, fig. 210.)

This form and *Cephalelus brunneus* Waterh. have been studied as representatives of the tribe *Cephalelini* of Kirkaldy, who treated this as distinct from the rest of the Jassinae and close to his tribe *Jassini*.

Pygofers large, produced into small spine-like processes in the posterior dorsal regions. The terminal abdominal segments of Jassine type.

Basal plates short, fused with each other throughout their length, forming a flat plate-like sclerite at the base of the aedeagus. Aedeagus very long, comparatively wider in the proximal region. Parameres elongated, styliform, twisted, hard and fine in the distal region. Sub-genital plates slightly elongated.

Remarks.—The posterior abdominal segments are similar to those in Jassinae; the parameres are more distinct from the Jassine type than even in *Tharra* (*Jassini* K.); the basal plates and the sub-genital plates are rather of Tettigonielline type. On the whole the genitalia are of the Tettigonielline type rather than the Jassine. Thus these forms do deserve to be treated as distinct from the rest of the Jassinae.

Doratura stylata Boh. (Pl. XXVI, fig. 211.)

The genitalia are absolutely of Jassine type, and are quite distinct from those in *Acocephalus*, along with which it was once placed in Acocephalinae by Edwards.

Basal plates thin, long, almost parallel to each other and with a long and slender prolongation. Aedeagus very wide proximally, gradually tapering down to a fine apex.

Parameres essentially of the same plan as in Jassinae, their distal halves, however, much elongated and bearing short nodule-like out-growths in the middle of their length. Sub-genital plates short, triangular and flattened.

Sub-family *Acocephalinae.*

Acocephalus albifrons Linn. (Pl. XXVI, fig. 212.)

Pygofers not produced posteriorly.

Basal plates short, flat, with a short prolongation. Aedeagus straight, cylindrical, tapering in the distal region, with two pairs of short conical spines, one in the middle of its length, the other just before the apex. Basal strut slightly differentiated. Parameres long, slightly flattened in the proximal region, where they bear small processes on their mesial face, touching the free ends of the basal plates (cf. *Idiocerus*). Sub-genital plates elongated, narrower than those in Jassinae or Tettigoniellinae, distinct from the sternite.

A. flavostriatus Don. (Pl. XXVI, fig. 213.)

This species differs from the above in having the proximal pair of the aedeagus-spines very much elongated.

Remarks.—The genitalia in *Acocephalus* resemble those in Bythoscopinae in several respects : form of basal plates, parameres and aedeagus. The sub-genital plates and post-abdominal segments are intermediate between those in Jassinae and Bythoscopinae.

Sub-family *Typhlocybinae.*

Forms examined : *Chlorita viridula* Fall, *Eupteryx germari* Zett., *E. auratus* L., *Typhlocyba rosae* L., *T. debilis* Dougl., *T. ulmi* L., *Dicraneura flavipennis* Zett.

Chlorita viridula. (Pl. XXVI, fig. 214.)

Pygofers large, especially produced posteriorly in their dorsal parts, and bearing backwardly-directed processes on their ventral borders. The Xth segment small and ring-like; sclerites round the anus small; anal style small, but distinct.

Basal plates extremely short, with a broad region of fusion which is only slightly prolonged. Basal foramen enormously large and elongated in the vertical direction, so that the aedeagus appears to be very long, but, actually, the part projecting free of the body wall is very small, conical, and with a blunt apex. The aedeagus basal struts, two in number, large, extending dorsally so as to surround the Xth segment like a collar. Parameres elongated and styliform. Sub-genital plates large, strap-like, ornamented with stiff hairs, distinct from the IXth sternite.

Eupteryx germari. (Pl. XXVI, fig. 215.)

Pygofers still more produced posteriorly. The basal plates and their prolongation together forming a triangular plate at the base of the aedeagus. Aedeagus is very wide in the proximal region, where it gives out two long and narrow processes, which lie parallel to it (aed. fl), as is the case in some Tettigoniellinae; the gonopore large and gaping on the sides. Basal strut slightly developed. Parameres stouter and elongated. Sub-genital plates resemble long plates, bent up in the distal region.

Eupteryx auratus. (Pl. XXVI, fig. 216.)

This differs in some important respects from the above, the two appear to belong to different genera. The IXth sternite is deeply notched at the anterior border. Aedeagus devoid of any lateral processes, with a pair of hook-like U-shaped processes at the apex (sp). Basal plates larger and with a distinct but short prolongation. Parameres thin and styliform. Sub-genital plates triangular in outline.

Typhlocyba rosae. (Pl. XXVI, fig. 217.)

Basal plates as in *E. germari*. Aedeagus wider proximally, gradually tapering in the distal region to a fine apex which is surrounded by a circlet of small spines; the basal strut differentiated. Parameres very fine and narrow at the apices, which are bent outwards. Sub-genital plates as in *E. auratus* triangular in outline, with the outer borders slightly thickened and curved up.

Typhlocyba debilis. (Pl. XXVI, fig. 218.)

This species differs from the above in having a comparatively smaller aedeagus, devoid of any hook at the apex, and parameres with small conical spines in the distal region.

T. ulmi. (Pl. XXVI, fig. 219.)

This species differs from the above two in having a long basal plates' prolongation, narrow (not triangular) sub-genital plates and a well-developed aedeagus basal-strut.

General remarks on Jassidae.

The above genitalia are essentially of the same type as is common in Cercopidae and Membracidae, coming near the latter in the presence of the basal plates and the form of the aedeagus and parameres, but at the same time

distinct from it by the Y-shaped appearance of the basal plates and by the form of the sub-genital plates which are distinct from the IXth sternite. In *Eurymela* the genitalia approach those in Cercopidae.

Within the family it is not possible to find distinct sub-types corresponding to the various sub-families, and the structure of the genitalia does not support the conclusions of authorities like Fieber, Ashmead, Van Duzee, Osborn, Edwards, etc., who propose elevating the sub-families, especially Bythoscopinae, to the rank of families. However, genitalia met with in the several groups can be *roughly* reduced to three sub-types, typically found in Bythoscopinae, Jassinae and Tettigoniellinae, respectively; of these the Jassine type is the central one from which the other two can be derived. The Bythoscopine and Jassine types resemble one another in the structure of the terminal abdominal segments, styliform aedeagus, etc. The Jassinae and Tettigoniellinae resemble each other in the form of the pygofers, structure of the sub-genital plates, etc. While in Bythoscopidae and Tettigoniellinae the basal plates and their prolongation are short, the Jassinae are specialised in having both very much elongated; moreover, the parameres in Jassinae are of characteristic form, having remote affinities with those in Tettigoniellinae. The Bythoscopinae are specialised in the structure of the sub-genital plates, which are entirely distinct from the IXth sternite, in the style-like shape of the parameres, in the reductions in size of the basal plates (T-shaped), and the development of the complicated basal struts. The Tettigoniellinae are specialised in the elongation of the pygofers, the Xth segment and the anal style, and the wide and bag-like form of the aedeagus. Thus the three sub-families, while resembling one another in some respects, differ in others and can be distinguished from one another by taking all the organs together. The Jassinae, specialised in several respects, retain the greatest number of primitive characters.

The genitalia in the rest of the sub-families come near one or other of the above three :—

Megophthalminae.—Essentially resemble Bythoscopinae; the sub-genital plates and basal plates are, however, of Jassine type.

Acocephalinae.—The genitalia in *Acocephalus* resemble those in the Bythoscopinae in the form of the basal plates,

aedeagus and parameres, and are intermediate between those in Bythoscopinae and Jassinae in the structure of the sub-genital plates and the posterior abdominal segments.

Gyponinae.—Essentially resemble Tettigoniellinae : some organs, *e.g.* the parameres in *Vulturnus*, are of almost Jassine type.

Ledrinae.—They seem to possess characters of both Tettigoniellinae and Bythoscopinae; forms like *Stenocotis* have genitalia of the Tettigonielline type, while the other forms examined, *Tituria Petalocephala*, approach the Bythoscopinae.

Typhlocybinae.—Resembles in most characters Bythoscopinae, in some Tettigoniellinae, but is on a different plan from Ledrinae. The above relations can be diagrammatically expressed as follows :—

Fig. 1.

Super-family *Fulgoroideae.*

The classification of this group is still in the melting pot. Stål considered it to be a family consisting of about a dozen sub-families, but the recent tendency (Hansen, Kirkaldy, Muir, etc.) is to elevate these sub-families to the higher rank. The relations of these sub-groups to one another being, therefore, "sub judice," in the following account almost no existing system has been followed, and the families have been so arranged as to make the modifications undergone by the genitalia easily understood and appreciated.

Family Ricaniidae.

Forms examined : *Ricania* sp., *Euricania splendida* F., *Pochazia sinuata* Stål, *Osaka hyalina* Dist., *Sassula osmyloides* Walk., etc.

Ricania sp. (Pl. XXVI, fig. 220.)

Tergal region of the IXth segment shorter than the lateral or the sternal; pygofers not much produced in the posterior direction, comparatively larger in the ventral region. The Xth segment very large, especially produced posteriorly in the ventral region, the anal opening being on its dorsal surface in the middle. Sclerites round the anus distinct; anal style well developed.

The aedeagus originates from a higher level near the tergal region, the basal plates, which are at the same place as in the previous families, near the sternal region, are very small, but their prolongation is very long. At the distal extremity of the prolongation there is a hood-shaped chitinous structure and the ejaculatory duct enters the basal foramen under this hood, which surrounds the duct like a sheath (sh) up to the base of the vesica, where the distal region of the sheath is fused. This structure, not found in other Homopterous families, resembles very much the basal-plates bridge of Heteroptera. Unlike that in other Homoptera, the aedeagus is large, bulbous and is differentiated into distinct phallosoma, conjunctiva and vesica (cf. Heteroptera). Phallosoma large and wide, especially in the distal region; phallosoma mouth very large and gaping at the sides. Conjunctiva thin, permanently fused in its proximal region to the inside of the phallosoma. Vesica very short, narrow, wider in the proximal region, tapering in the distal to a fine apex which bears the gonopore. From the junction of conjunctiva and vesica originate two long diverticula, secondarily solidified, one on each side of the vesica, meeting each other in their proximal region above and below the latter, thus forming a sheath round it. These appendages will be termed conjunctiva appendages, but they do not correspond in position to the similarly named appendages in Heteroptera. The conjunctiva appendages are very long, protruding out of the phallosoma mouth, strap-like, narrow and heavily chitinised in their distal region, where they bear secondary appendages which are thin, V-shaped and horny (sp).

The chitinisation of the dorso-lateral regions of the aedeagus-base is continued dorsally into a pair of struts, which reach the base of the Xth segment (cf. some Jassidae).

Parameres large, leaf-like, flattened in the vertical plane, with their bases in contact with the basal plates inside the body cavity.

Sub-genital plates not developed.

Euricania splendida. (Pl. XXVII, fig. 221.)

Phallosoma much wider and not so much lobed in the region of the mouth. Conjunctiva appendages without any secondary appendages. Parameres slightly more flattened, but shorter than in *Ricania*.

Pochazia sinuata. (Pl. XXVII, fig. 222.)

Phallosoma long, much longer ventrally, its mouth large, more heavily chitinised in the proximal region. Conjunctiva appendages extremely long, narrow and whip-like in their distal regions, bearing secondary appendages, one on each side, fused in the middle of their length to the primary appendages.

Remarks.—Pochazia seems to be nearer *Ricania* than *Euricania* is to the same.

Osaka hyalina. (Pl. XXVII, fig. 223.)

As in the above form phallosoma much longer ventrally and notched in the distal region; its dorso-lateral regions having two pairs of small rounded projections, one behind the other. Conjunctiva appendages very narrow distally, as in *Euricania*. Secondary processes, one on each, present. Parameres comparatively narrow.

Family Flatidae.

Forms examined: *Melicharia tripars* Walk., *Hansenia glauca* Kirby, *Phyllyphanta* sp., *Colgar peracuta* Walk., *Ityraea nigrocincta* Walk., *Flatoides* sp., etc.

Melicharia tripars. (Pl. XXVII, fig. 224.)

The tergal region of the IXth segment extremely small, the pygofers gradually becoming larger to meet the large sternal region. Aedeagus elongated, straight, pointing in the posterior direction. Phallosoma cylindrical, not bilobed in the region of the mouth, the latter smaller than in Ricaniidae. Conjunctiva appendages only slightly flattened, without secondary appendages, blunt at the apices. Vesica very narrow. Parameres extraordinarily flattened, squarish, slightly produced in the posterior dorsal corners.

Hansenia glauca. (Pl. XXVII, fig. 225.)

Conjunctiva appendages very much flattened, thin, in their proximal region meeting each other above and below the vesica, forming a distinct sheath round it, in the distal region they being very narrow and hard and bearing heavily chitinised, thin, secondary appendages. Vesica better developed. Parameres less flattened.

Phyllyphanta sp. (Pl. XXVII, fig. 226.)

The genitalia almost similar to those in *Hansenia*. The secondary appendages borne by the conjunctiva appendages extremely large, spine-like, with their one extremity branched and dentated. Parameres comparatively more flattened.

Colgar peracuta. (Pl. XXVII, fig. 227.)

Phallosoma much shorter in its median dorsal and ventral regions than in the laterals, the latter enormously produced in the posterior direction as thin, whip-like processes, turned towards the aedeagus base. Conjunctiva appendages extremely expanded, leaf-like, without any secondary processes.

Family Issidae.

Forms examined: *Tetrica bifasciata* Dist., *Caliscelis eximia* Stål, *Dindinga oculata* Dist., *Hemisphaerius* sp., *Thabena patula* Walk., *Gergithus proteus* Dist., etc.

Tetrica bifasciata. (Pl. XXVII, fig. 228.)

Aedeagus pointing straight in the posterior direction, the basal struts well developed. Phallosoma elongated, thick-walled, divided into several lobes in the region of its mouth, the latter therefore very large. Conjunctiva appendages very stout, slightly flattened, almost as long as phallosoma, bearing secondary processes. Vesica short and narrow. Parameres almost squarish in outline, but very much prolonged in the posterior dorsal regions.

Caliscelis eximia. (Pl. XXVII, fig. 229.)

Phallosoma shorter, but much wider, especially in the distal region; its mouth very large, extending on the ventral side. Conjunctiva appendages rod-like, slightly flattened, without any secondary appendages, pointed at the apices, the latter protruding a little out of the phallosoma mouth. Vesica wide, blunt at the apex.

Dindinga oculata. (Pl. XXVII, fig. 230.)

Phallosoma very wide, barrel-shaped, much longer ventrally, consequently the mouth very large and extending on the dorsal side. Conjunctiva appendages very strong, flattened, and having each a well-developed secondary appendage. Vesica small. Parameres with thin U-shaped hooks in the posterior dorsal corners.

Hemisphaerius sp. (Pl. XXVII, fig. 231.)

Aedeagus deeply bent in its proximal region; the basal struts very well developed. Phallosoma long, of uniform width, produced into small conical processes in the region of the mouth. Conjunctiva appendages rod-like, narrow, as long as the phallosoma, without secondary processes. Parameres, like those in *Dindinga*, with thin spines in the postero-dorsal corners, but in outline characteristic of the present form.

Thabena patula. (Pl. XXVIII, fig. 232.)

Genitalia quite near to those in *Tetrica*.

Aedeagus, however, very short; the phallosoma lobed in the region of the mouth, the dorso-lateral lobes hard and having the appearance of appendages. Conjunctiva appendages well developed and slightly flattened in the middle. Parameres only slightly produced in the posterior dorsal regions.

Family Lophopidae.

Pyrilla sp. (near **perpusilla** Walk.). (Pl. XXVIII, fig. 233.)

Genitalia essentially of the same type as in the previous families, but modified in one important respect: the reduction to extinction of the vesica part of the aedeagus.

Aedeagus with a pair of well-developed basal struts. Phallosoma lobed and produced into long processes in the region of its large mouth. Conjunctiva appendages well developed and having each a secondary process in the distal region. Basal-plates bridge enormously enlarged. Parameres very large and flattened.

Ivinga typica Dist. (Pl. XXVIII, fig. 234.)

The IXth segment is narrower than in *Pyrilla*. The Xth is cylindrical and, unlike in most Fulgoroideae, it is longer dorsally than ventrally, so that its dorsal surface projects like a hood above the anal opening.

Aedeagus very long, phallosoma slightly membranised in its distal half. Conjunctiva appendages very small.

Family Eurybrachidae.

Eurybrachys dilatata Walk. (Pl. XXVIII, fig. 235.)

Aedeagus, as in the above family, differentiated into phallosoma and conjunctiva only.

Phallosoma long, but deeply incised, forming distinct lobes, the incisions extending even to its proximal region. Conjunctiva hardly separable from the phallosoma, except at the extreme base. Conjunctiva appendages very highly developed, hard, stout and conspicuous, bearing small secondary processes. At the base of the conjunctiva appendages, in the virtual position of the vesica, there is another pair of short conical appendages (ap″). Basal plates, their prolongation and bridge delicate and slender. Parameres flat and broad.

Family Dictyopharidae.

Forms examined : *Dichoptera hyalinata*, *Dictyophara* sp., *Putala figurata* Gerst., *Centromeria viridistigma* K., *Aselgeoides insularis* Dist., etc.

Dichoptera hyalinata. (Pl. XXVIII, fig. 236A ; Pl. XXXII, fig. 236B.)

Pygofers are slightly projecting posteriorly in the dorsal regions.

Aedeagus with well-differentiated basal struts, differentiated into phallosoma and conjunctiva only, the part corresponding to the vesica being not present.

Phallosoma funnel-shaped, comparatively thick in the proximal half, lobed round the mouth, its lateral regions very much prolonged posteriorly and thinly chitinised. Conjunctiva thickened and heavily chitinised in its distal lateral regions. Conjunctiva appendages long, protruding out of the phallosoma mouth, curved and flattened. Parameres large, flattened, narrower in the proximal regions, gradually widening in the distal.

Dictyophara sp. (Pl. XXVIII, fig. 237.)

Pygofers longer in the middle than in the dorsal or ventral regions.

The lateral regions of the phallosoma round its mouth very much enlarged and membranous, and with the lining conjunctiva appearing as two balloon-like structures. Conjunctiva membranous throughout. Conjunctiva appendages rod-like. Parameres elongated.

Putala figurata. (Pl. XXVIII, fig. 238.)

The phallosoma is still more enlarged and membranised in the distal lateral regions, which are, moreover, covered with short

stiff bristles. Conjunctiva appendages protrude greatly out of the phallosoma mouth.

Centromeria viridistigma. (Pl. XXVIII, fig. 239.)

Phallosoma extremely short in its dorsal and ventral regions, and sufficiently chitinised only in its proximal region; the rest of phallosoma, which consists chiefly of the large lateral regions, being membranous. The sheath formed by the basal-plates bridge heavily chitinised. Conjunctiva appendages slightly bent at the distal ends. Parameres flat, slightly elongated, bearing one or two ridges along the dorsal margins.

Remarks.—This form connects the Dictyopharidae with the next family Fulgoridae.

Aselgeoides insularis Dist. (Pl. XXVIII, fig. 240.)

This form is very interesting. Distant founded *Aselgeoides* as a new genus of Dictyopharidae. The present is the only species of the new genus described by him.

The genitalia are quite different from those in any other member of the present family and are absolutely of Cixiid type, coming near to those in *Adolendana* (fig. 246). So most probably this so-called new Dictyopharid is actually a Cixiid, and its genitalia will be described along with other genera of that family (p. 223).

Family Fulgoridae.

Forms examined: *Fulgora candelaria* L., *F. maculata* Oliv., *Gebenna sylvia* Stal, *Scamandra* sp., etc.

Gebenna sylvia. (Pl. XXIX, fig. 241.)

The aedeagus is fundamentally of the Dictyophorid type, the lateral regions of the phallosoma are enormously enlarged, membranised, and appear as bag-like structures; in fact the phallosoma is only stiff in the most proximal region, otherwise it, along with the conjunctiva, is very thin and delicate. The above described balloon or bag-like regions give out secondary, even tertiary diverticula. These "bags" hang loosely or are folded fan-wise in the resting condition, but when the aedeagus has entered the female parts, become turgid with the flow of body fluid into them, and thus serve as holding organs. The conjunctiva appendages are like thin delicate rods, slightly protruding out of the phallosoma mouth. The basal plates and their prolongation are of the usual

form, the "bridge" is wide and slightly chitinised, the sheath formed by it is heavily thickened. The parameres touch each other at their ventral margins in the proximal region.

Fulgora candelaria. (Pl. XXIX, fig. 242.)

Genitalia are of the same type as in the previous genus; they have been figured when the aedeagus is fully turgid. The phallosoma is membranous over a greater area. The conjunctiva appendages are very delicate. Parameres almost rectangular in outline.

Scamandra sp. (Pl. XXIX, fig. 243.)

Phallosoma stiff for a longer distance than in *Fulgora*. Its distal lateral regions with the lining conjunctiva are produced into as big a bag as in *Gebenna*. The conjunctiva appendages are longer than in either of the above forms. Basal-plates bridge extremely large. Parameres very much elongated.

Family Cixiidae.

Forms examined: *Cixius nervosus* L., *Brixia stellata* Dist., *Adolendana typica* Dist., *Caneirona indica* Dist., *Mundopa sita* Dist., *Oliarus nawarae* Dist., *Volcanalia picturata* Dist., *V. fumosa* Dist., *V. sulphurata* Dist., *V. atrovaria* Dist.

The genitalia in this and the following families are modified in a few important respects.

Cixius nervosus. (Pl. XXIX, fig. 244.)

The pygofers are a little produced posteriorly in their dorsal region; the sternite is produced into a small conical process in the median ventral line.

The aedeagus is differentiated into two regions, the long, thick-walled and wider proximal, and the short, narrow and thin-walled distal, the latter bent over the former and pointing towards the aedeagus base. The distal region is two-layered, the extreme apical region of the aedeagus being thin and invaginated. The ejaculatory duct surrounded by its sheath traverses the whole length of the proximal part to meet the distal margins of the invaginated portion.

In Dictyopharidae the aedeagus is differentiated into two regions, phallosoma (outer) and conjunctiva, the latter equally long, lining the former, and reaching the basal foramen; the condition in *Cixius* can be derived from this

by imagining that the proximal half of the conjunctiva has also become permanently exposed, while the distal remains invaginated. So the distal margins of the conjunctiva do not reach the basal foramen, but end about the distal region of the phallosoma, and consequently the ejaculatory duct, instead of ending near the basal foramen, is prolonged to meet the now posteriorly located distal margins of the conjunctiva, and the ejaculatory sheath is continued throughout its length. Therefore, in the Cixiid aedeagus, the proximal region corresponds to the phallosoma, and the distal to the conjunctiva; the proximal half of the conjunctiva which has become permanently exposed, will be termed *conjunctiva exserta* (cnj. ex) while the word " conjunctiva " will be used for the distal region only.

Kershaw and Muir believe that the distal region in the Cixiid aedeagus corresponds to the vesica (their " penis ") of Flatidae, etc. If it is so, then its internal membranous lining, which is as wide as the outer wall and not duct-like, is the ejaculatory duct, which therefore differs anatomically from that in any other Fulgoroid. Moreover, their interpretation brings the Cixiidae nearer to the Ricaniidae, Flatidae, etc. (having a vesica), than to the Dictyopharidae (having no vesica), a fact not supported by any system of classification of Fulgoroideae so far proposed by different Homopterists, including Muir himself. But probably Kershaw and Muir did not notice the above great difference (presence or absence of vesica or " penis ") between the genitalia in Ricaniidae, Flatidae, etc., on the one hand (having a vesica) and Dictyopharidae, Fulgoridae, etc., on the other (having no vesica). No reference to this fact in any form is made in their paper under reference, they consider all the above families to have one sub-type of genitalia (pp. 208–209).

To revert to the anatomy of the genitalia in *C. nervosus*, the phallosoma is wide, but not of uniform diameter, and has a pair of appendages in the distal region (phs. sp). The conjunctiva exserta is long, comparatively narrower in the proximal region. There is no conjunctiva appendage. Parameres very narrow in the proximal region, expanded in the distal.

Brixia stellata. (Pl. XXIX, fig. 245.)

Genitalia almost similar to those in *Cixius*.

Tenth segment shorter and wider. Phallosoma produced into

several conical ridges, with a spine in the median dorsal line. Conjunctiva wider in the distal region. Parameres less expanded in the distal region.

Adolendana typica. (Pl. XXIX, fig. 246.)

Phallosoma of almost uniform width, with three spines, two of which being dentate along their borders. Conjunctiva exserta slightly more chitinised in the proximal ventral region. Parameres still narrower.

Aselgeoides insularis Dist. (Pl. XXIX, fig. 240.)

This form belongs to the Dictyopharidae according to Distant; its genitalia are distinctly of Cixiid type, so it is described here. As in all Cixiidae, but unlike what occurs in any Dictyopharidae, the proximal region of the conjunctiva is permanently exposed and the ejaculatory duct along with its sheath is prolonged in the posterior direction to meet the distal margins of the conjunctiva. The parameres are of the type common in Cixiidae. The aedeagus comes near to that in *Adolendana*, the phallosoma is comparatively narrower and has only two spines, one of which is very much elongated, reaching the aedeagus base.

Referring to characters other than the genitalia, Mr. China, Brit. Mus. Nat. Hist., informs me that *Aselgeoides* has some characters of Cixiidae and others of Dictyopharidae.

The structure of the genitalia definitely locates it amongst the Cixiidae as a species of *Adolendana*.

Caneirona indica. (Pl. XXIX, fig. 247.)

The Xth segment short and comparatively wider in the distal region. Phallosoma with three spines. Conjunctiva exserta heavily chitinised in its median ventral region, the latter being continued as a spine-like process beyond the distal extremity. Parameres small.

Mundopa sita. (Pl. XXIX, fig. 248.)

Pygofers slightly different in outline. The Xth segment very much expanded.

Phallosoma very wide, constricted and twisted at several places, produced into a spine-like process in its distal dorsal region, bearing a solid blunt spine in the middle of its length. Conjunctiva short.

conical in outline, resembling a "vesica." Parameres narrow, bearing several ridges on their dorsal margins.

Oliarus nuwarae. (Pl. XXIX, fig. 249.)

The genitalia resemble those in *Mundopa*. The conjunctiva, however, is very short, and the ejaculatory duct may be said to finish at the distal extremity of the phallosoma.

Volcanalia picturata. (Pl. XXIX, fig. 250.)

Pygofers not projecting at all posteriorly. The Xth segment short and cylindrical; the anal opening at the distal extremity; the anal style conspicuous.

The basal-plates prolongation very stout. Aedeagus without a part corresponding to the conjunctiva, so what is present being equal to the phallosoma region. Aedeagus basal struts very well developed, encircling the basal foramen and continued dorsally, reaching the Xth segment. Phallosoma elongated, with a small posteriorly projecting spine at its distal end, below the gonopore, and a pair of spines of the same size in the lateral regions, produced into a median ventrally directed keel, which is curved and bifurcated at the distal extremity.

Ejaculatory duct and its sheath, conspicuous in the previous genera, are highly dechitinised. Parameres resembling thin curved plates, finely pointed at the apices.

Remarks.—The above genitalia differ in several respects from those in other genera of Cixiidae examined and come near those in the Delphacidae—*e.g.* form of the pygofers, Xth segment, structure of aedeagus, basal struts, basal-plates prolongation, etc., are all similar to those in the Delphacidae. Distant described *Volcanalia* as a new genus of Cixiidae, the structure of the genitalia tends to point out that *Volcanalia* should be located amongst the Delphacidae.

V. fumosa. (Pl. XXX, fig. 251.)

The genitalia in this species are identical with those in *V. picturata*. It is very doubtful whether they deserve the rank of separate species.

V. sulphurata. (Pl. XXX, fig. 252.)

Phallosoma long and narrow, the median ventral keel originating from near its distal end, the spine on the rim of the mouth small,

no spine in its lateral regions. Ejaculatory duct with its sheath conspicuous. Parameres much narrower in the middle.

V. atrovaria. (Pl. XXX, fig. 253.)

Phallosoma without a keel-like process, with three spines, as in *V. picturata*. Parameres extremely narrow.

Family Tropiduchidae.

Ossa formosa Kirk. (Pl. XXX, fig. 254.)

Both the posterior abdominal segments and the genitalia distinctly of Cixiid type.

Aedeagus differentiated into two regions, the proximal corresponding to the phallosoma and the distal to the conjunctiva, the latter being enormously elongated, bent in the middle and pointing towards the posterior. It seems that the whole of the conjunctiva is exposed—an advance on Cixiidae—as the ejaculatory duct surrounded by its sheath can be recognised up to the apex. Phallosoma shorter and wider.

Family Derbidae.

Forms examined: *Lamenia caliginea* Stål, *Zeugma monticola* Kirk., *Philadelpheia pandani* Kirk., *Basileocephalus thaumatonotus* Kirk., *Nisia atrovenosa* Leth., *Phenice moesta* Westw., *Aquaelicium typicum* Dist., etc.

Zeugma monticola. (Pl. XXX, fig. 255.)

Pygofers small. The Xth segment large, bilobed in the posterior region.

As in Cixiidae, aedeagus differentiated into two regions: long proximal and short distal, corresponding to the phallosoma and conjunctiva respectively. Phallosoma very wide at the base, otherwise narrow and cylindrical, comparatively more thickened in the ventral region. Conjunctiva exserta narrow in the proximal region, gradually widening in the distal, with a pair of more heavily chitinised thickenings in its ventral region, which distally diverge from each other and bear short spines. Ejaculatory duct, its sheath and basal-plates bridge very delicate. Basal plates distinct, forming a straight bar connecting the two parameres, their prolongation, however, very delicate. Parameres very much elongated.

Lamenia caliginea. (Pl. XXX, fig. 256.)

The Xth segment much smaller. Phallosoma and conjunctiva exserta equally well chitinised, comparatively more so in the ventral regions.

Philadelpheia pandani. (Pl. XXX, fig. 257.)

The aedeagus has almost no region corresponding to the distal region (conjunctiva) in the above genera, so the part present corresponds to the phallosoma only. It is thick comparatively, wider in the distal part, where it bears several irregular spine-like processes round the large "gonopore." Ejaculatory duct wide and membranous, its sheath, the basal-plates bridge, their prolongation, and the plates themselves are slender and delicate. Parameres large and wide.

Basileocephalus thaumatonotus. (Pl. XXX, fig. 258.)

As in *Philadelpheia* the aedeagus has almost no distal region corresponding to the conjunctiva. It is straight, cylindrical, has numerous long and fine spines round the gonopore. The aedeagus basal struts are very well developed, they bear a pair of posteriorly directed long and fine spines. Parameres flat and wide.

Phenice moesta. (Pl. XXX, fig. 259.)

Pygofers very small, the Xth segment enormously prolonged in the posterior direction.

Aedeagus as in the above two forms without any distal part, with a pair of conical spines in the distal region near the gonopore. Parameres large, flattened, produced into narrow and long apophyses in the proximal regions.

Aquaelicium typicum. (Pl. XXX, fig. 260.)

Same plan as in the above form.

Aedeagus (phallosoma) cylindrical, with several carinated processes round the large gonopore, which points towards the left. Parameres large, leaf-like, ridged along their dorsal margins in the proximal regions.

Nisia atrovenosa.* (Pl. XXX, fig. 261.)

The IXth segment larger in the ventral region; the Xth short, only slightly projecting beyond the anus.

Aedeagus (phallosoma) very wide, short, not of uniform diameter, without any processes round the narrow gonopore. The basal-plates prolongation and the bridge are well chitinised, but the sheath round the ejaculatory duct, which is delicate itself, is inconspicuous. Parameres long and narrow.

Remarks.—The different genera examined rally round two forms—*Zeugma* and *Nisia*; in the former group the con-

* Muir has shown that *Nisia* belongs to the Cixiidae (Meenoplinae) and not to the Derbidae as located by Melichar and Distant (W. E. C.).

junctiva is present, while in the latter it is absent. But as the two types are connected by intermediate forms, e.g. *Basileocephalus*, *Aquaelicium*, etc., it is highly probable that the family Derbidae does not deserve to be differentiated into two sub-families, Derbinae and Nisinae, as has been suggested (though with hesitation) by Kirkaldy.

Family Tettigometridae.

Tettigometra sp. (Pl. XXX, fig. 262.)

Pygofers almost of the Cixiid type. The Xth segment, however very short and ring-like.

Aedeagus differentiated into two regions: cylindrical, narrower and thick in the proximal region, wider and membranised, except in the median ventral line for some distance, in the distal. Gonopore small, ejaculatory duct delicate, its sheath not distinguishable. Basal plates insignificant, with a well-developed prolongation and a small bridge. Parameres slender, fused with each other along their mesial borders in the proximal region.

Remarks.—The general plan of the genitalia and the posterior body segments is the same as in Cixiidae, the aedeagus proper is, however, somewhat different; it is difficult to decide whether the Tettigometrid aedeagus corresponds to phallosoma only or to both phallosoma and conjunctiva of the Cixiid aedeagus.

Family Achilidae.

Robigalia butleri Dist.* (Pl. XXX, fig. 263.)

The IXth segment comparatively larger in its ventral region; the Xth short and produced into a pair of flap-like lobes.

Aedeagus short, wider proximally, undifferentiated into any regions, and most probably equivalent to the phallosoma part of the Cixiid aedeagus; thus the tendency towards the reduction of the distal part of the aedeagus, met with in Derbidae, being very well marked in the present form, as well as in the families that follow.

Basal-plates prolongation and the bridge well developed, but the sheath formed by the latter round the ejaculatory duct being not recognisable. Parameres large, very much expanded in the proximal region.

* *Robigalia* as shown by Muir belongs to the Ciciidae (Meenoplinae) and not to the Archilidae as located by Distant (W. E. C.).

Family Achilixiidae.

Achilixius tubulifera (Melichar). (Pl. XXX, fig. 264.)

The IXth segment is narrower in the dorsal region, gradually enlarging in the ventral; the Xth is short and broad; anus on the dorsal surface in the proximal region; anal style small but distinct.

Aedeagus very small, cylindrical, and seems to correspond to the phallosoma region only of the Cixiid aedeagus. Parameres small, thin and very narrow.

Family Delphacidae.

Forms examined: *Perkinsiella saccharicida* Kirk., *Opiconsiva colorata* Dist., *Chloriona glaucescens* Fieb., *Delphax pellucida* Fall, *Stiroma nigrolineata* Scott, *S. pteridis* Boh., *Dicranotropis hamata* Fieb., *Ugyops kellersi* Muir, etc.

Perkinsiella saccharicida. (Pl. XXX, fig. 265.)

The IXth segment is shorter in the dorsal region and gradually enlarges in the ventral, the sternal region is produced posteriorly into a pair of conical processes. The Xth segment is short, wider in the distal region, where, ventrally, it gives out a pair of processes. The anal opening is at the distal extremity, the anal style is broad and conspicuous.

Aedeagus straight, cylindrical, without any distal exposed or invaginated part, and most probably corresponding to the proximal part (phallosoma) of the aedeagus in Cixiidae. Ejaculatory duct thin, straight, ending at the large gonopore located on the dorsal surface. Aedeagus basal strut very well developed, bifurcating near the base of the Xth segment. Basal plates themselves very short and, as usual, having a well-developed prolongation and bridge, the sheath formed by the latter round the ejaculatory duct being recognisable only in the proximal region. Parameres resemble thin, narrow and slightly curved plates, and bear short ridges along the borders.

The segmental membrane is thicker than in the previous families; it is specially so between the aedeagus and the parameres, but immediately around the bases of the latter it is highly membranous.

According to Kershaw and Muir, the aedeagus in Delphacidae is equivalent to the distal region of the aedeagus or the "penis" in Cixiidae, the proximal region, the phallosoma, their "periandrium," having been reduced totally or to a "chitinous ring round the penis in the body

wall": this chitinous ring is the same that I have referred to as the basal strut. It is very difficult to imagine that the aedeagus in Delphacidae corresponds to the distal region and not to the proximal (phallosoma), because (i) we do find different grades of reduction of the distal region in Derbidae, Achilidae, Achilixidae, etc., while the proximal region remains of the same size and form. (ii) In the family Cixiidae itself we find certain forms, e.g. *Volcanalia*, etc., where the distal part is reduced. (iii) The basal strut which they think is the reduced "periandrium" (phallosoma) is present in many Fulgoroideae (most of the previous families) which have a well-developed phallosoma as well.

Opiconsiva colorata. (Pl. XXX, fig. 266.)

The posterior ventral region of the Xth segment produced into two well-developed, ventrally directed lobes.

Aedeagus (phallosoma) cylindrical, long, bent near the base, with several tooth-like ridges in the distal dorsal region; the basal strut well developed, encircling the basal foramen and dorsally reaching the base of the Xth segment. Parameres bilobed in the distal region.

Chloriona glaucescens. (Pl. XXXI, fig. 267.)

The Xth segment produced in its posterio-ventral region into a pair of lobes which are very much flattened.

Aedeagus shorter, with a large gonopore, pointing to the right side. Parameres tapering in the distal region to fine apices.

Delphax pellucida. (Pl. XXXI, fig. 268.)

The general plan is the same as in *Opiconsiva* and *Chloriona*.

Aedeagus bent in the middle, its apex pointing towards the ventra side. Parameres wide in the proximal region, gradually tapering in the distal.

Stiroma nigrolineata. (Pl. XXXI, fig. 269.)

Aedeagus wide, slightly bent down in the distal region.

Basal plates, their prolongation and bridge very stout and heavily chitinised, sheath round the ejaculatory duct also fairly chitinised for a considerable distance.

S. pteridis. (Pl. XXXI, fig. 270.)

The Xth segment is very deeply lobed in the posterior region. The aedeagus has a longitudinal row of teeth in the mid-dorsal and

mid-ventral regions. Parameres narrow, bent in the middle, boot-shaped, their bases produced into long apophyses.

Dicranotropis hamata. (Pl. XXXI, fig. 271.)

Aedeagus small, narrow, comparatively much flattened and wedge-shaped in the distal region; the basal strut forming a complete ring round the base, at a little distance from it.

Parameres, as seen from the side, resembling human feet in outline. Segmental membrane enormously thinned between the bases of the parameres.

Remarks on Fulgoroideae.

The tergite of the IXth segment is generally short, its lateral regions gradually enlarge to meet the large sternite, the latter is sometimes produced posteriorly into one or two small conical processes. The Xth segment is often very large, the anus being on its dorsal surface at about the middle; in some, *e.g.* Delphacidae, etc., it is relatively small and ring-like. The sclerites round the anus (XI) conical, projecting above the anal opening, the anal style very well developed.

The aedeagus shows great modifications in the different families: in Flatidae, Ricaniidae, etc., it is differentiated into phallosoma, conjunctiva and vesica; in Dictyopharidae, Fulgoridae, etc., the part corresponding to the vesica is not developed; in Cixiidae, etc., the aedeagus differs from that in Dictyopharidae in the fact that the proximal region of the conjunctiva is also permanently exposed, so that its distal margins do not reach the basal foramen; therefore, the aedeagus appears to be two-segmented, the proximal segment being phallosoma, the distal conjunctiva; in Delphacidae, etc., the part corresponding to the distal region in Cixiidae is abortened, and the aedeagus is simple, short and cylindrical.

The basal plates throughout the super-family are very small, but have a very much elongated prolongation, which, at its distal extremity, has a hood-shaped structure, most probably corresponding to the basal-plates bridge of Heteroptera; the bridge is posteriorly prolonged, forming a sheath round the delicate ejaculatory duct, till the latter enters the vesica, with the base of which the sheath becomes continuous. In Dictyopharidae, Fulgoridae, etc., where there is no vesica, both the ejaculatory duct and its sheath

end at the distal margins of the conjunctiva, while in Cixiidae, etc., where, owing to the partial permanent evagination, the conjunctiva ends near the distal region of the phallosoma, the ejaculatory duct as well as its sheath are prolonged posteriorly to meet the conjunctiva. The parameres are generally flattened in the vertical plane. The sub-genital plates are not developed, unless the short conical processes at the posterior margin of the IXth sternite may be considered as such.

The above genitalia, while resembling those in the superfamily Cicadoideae in the fundamental plan—the form of the posterior abdominal segments, position of the basal plates on the internal surface of the segmental membrane inside the body cavity, general position of the aedeagus and the parameres, etc.—differ from them, especially from those in Membracidae, Cercopidae and Jassidae, in some well-defined features: the largeness of the Xth segment, the almost complete absence of the sub-genital plates, the large size of the IXth sternite, the differentiation of the aedeagus into phallosoma, conjunctiva, etc., the reduction of the basal plates, and the elongation of their prolongation and the development of the bridge. The Fulgoroideae resemble the Cicadidae in the structure of the posterior body segments, the form of the anal style, the absence of the sub-genital plates, etc.

Completely exposed aedeagus of some Cixiidae, Delphacidae, Tettigometridae, resembles that in Cicadidae, Membracidae, Jassidae, etc. By the way, it may be mentioned that Cixiidae, etc., unlike the rest of Fulgoroideae, have a complete ovipositor like Cicadidae, Jassidae, etc.

In the structure of the basal plates, the Fulgoroideae are more specialised than any other family of Auchenorhynchous Homoptera. As will be shown hereafter, the genitalia in Psyllidae approach those in Cixiidae.

In the development of the basal-plates bridge and the differentiation of the aedeagus into different regions, the Fulgoroideae come near the Heteroptera.

Thus the Fulgoroideae are a very old and independent branch of the Homoptera.

The genitalia in the different Fulgoroid families can be reduced to four types :—

(1) Aedeagus differentiated into phallosoma, con-

junctiva and vesica. Distinct conjunctiva appendages present. Ricaniidae, Flatidae and Issidae.

(2) The same as (1), but the vesica part of the aedeagus not developed. Dictyopharidae, Lophopidae, Eurybrachidae and Fulgoridae.

It may be mentioned that these families, while resembling one another in the absence of the vesica, are otherwise modified on different lines. The Lophopidae come near

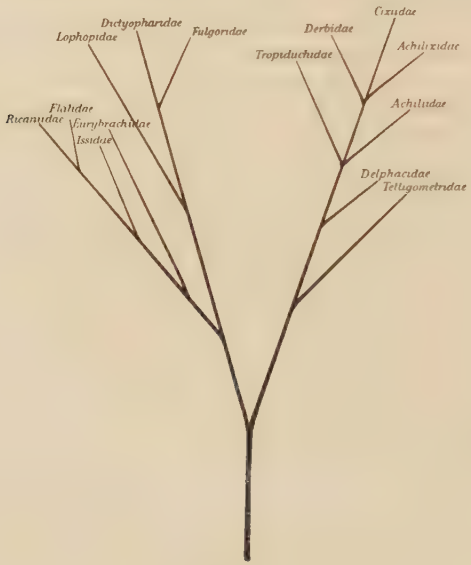


Fig. 2.

the Flatidae, Eurybrachidae near Issidae, Dictyopharidae near Ricaniidae. The Fulgoridae are a specialisation of the Dictyopharidae.

(3) The same as in Dictyopharidae (2) except that the proximal half of the conjunctiva is permanently exposed. This exposed area is distinct from the phallosoma region and thus gives a two-segmented appearance to the aedeagus. Conjunctiva appendages absent. Cixiidae, Derbidae in part, Tropiduchidae. In Tettigometridae the above two segments are not distinct.

(4) The same as (3), but the distal segment of the aedeagus abortened. Delphacidae, Achilidae, Achilixiidae, Derbidae in part.

Evidently all the above types are easily derivable from one another, but it is difficult to say which is the starting-point. The Delphacid type (4) is a specialisation of the Cixiid type (3). The remaining three, Ricaniid, Dictyopharid and Cixiid types form a continuous series, certainly one would prefer to call the Cixiid type, in which most of the aedeagus is exposed, more primitive than the Ricaniid. In fact, the aedeagus in the Tettigometridae seems to be the most primitive, in being wholly exposed, while in the Cixiidae it is two-segmented, its extreme distal region being invaginable, and thus shows the line of the evolution of the Dictyopharid and the Ricaniid types.

The above relationship is expressed diagrammatically in fig. 2 :—

Series IX. STERNORHYNCHA.

Super-fam. *Psylloideae.*

Family Psyllidae.

Tribe *Psyllaria.*

Arytaena genistae Latr. (Pl. XXXI, fig. 272.)

The IXth segment is very large, especially in the sternal region, which is curved up at its posterior margin. The Xth is very much elongated, cylindrical, thick-walled in the dorsal and lateral regions, membranous in the ventral; the sclerites round the anus and the anal style are insignificant.

The aedeagus is much wider proximally, where it is thickened only in its dorsal region; beyond the base it is extremely narrow, very long, and appears to be composed of two segments hinged together (cf. Cixiidae); its distal extremity is slightly flattened and curved, pointing towards the anterior end of the body. The aedeagus basal strut is present. Basal plates very small, with a long and slender prolongation, without any bridge, etc. Parameres flattened in the vertical plane, and resembling thin plates. Sub-genital plates not developed.

Psylla hyppophaes Foerst. (Pl. XXXI, fig. 273.)

Differs very little from the above. The IXth tergite extremely short. The Xth rather longer. The distal extremity of aedeagus not so much bent and curved. Parameres narrower.

Tribe *Liviaria.*

Livia juncorum Latr. (Pl. XXXI, fig. 274.)

Genitalia almost identical with those in Psyllidae.
Parameres short and leaf-like.

Tribe *Aphalararia.*

Aphalara nebulosa Zett. (Pl. XXXI, fig. 275.)

The general plan is the same as in the above forms. The Xth segment is short, but ventro-posteriorly produced into two large and leaf-like processes.

The proximal segment of the aedeagus is comparatively much longer than the distal, the apex is flattened. Parameres very narrow.

Rhinocola ericae Curt. (Pl. XXXI, fig. 276.)

The Xth segment differs from that in *Aphalara* and resembles the one in the previous tribes in being very much elongated and cylindrical. Parameres wider, comparatively narrow in the distal regions.

Remarks on Psyllidae.

The genitalia in all respects resemble those in Fulgoroidea, especially Cixiidae. They are more specialised in the dechitinisation of the IXth tergite and the lateral and ventral regions of the aedeagus base, in the elongation and narrowness of the aedeagus itself, and the absence of the basal plates bridge, etc.

James Edwards (Hemip.-Homop. Brit. Isl., 1896, p. 227) raised the tribes Liviaria, Aphalararia, etc. to the rank of distinct families. The genitalia of these tribes are so similar to one another and to those of Psyllaria that, as compared with other families of Rhynchota, they do not deserve to be treated even as distinct sub-families. The case is similar with regard to the different genera.

Super-fam. *Coccoideae.*

Family Coccidae.

Monophlebus stebbingi. (Pl. XXXI, fig. 277.)

The abdominal segments hardly distinct from one another, more or less membranised, and bearing long hairy segmented appendages

in the lateral regions. The area round the anus and the aedeagus is, however, fairly well chitinised.

Aedeagus undifferentiated into phallosoma, endosoma, etc., long, fairly wide. Aedeagus wall thick but very flexible, the distal region being invaginable into the proximal, the two then might be termed phallosoma and endosoma, but anatomically there being no difference between the two. Ejaculatory duct wide and extremely elastic.

The base of the aedeagus is very heavily chitinised, and its chitinisation is continued dorsally, reaching the anus, and is produced into a posteriorly directed shelf-like appendage, just above the aedeagus, to which it serves as a protective organ.

Basal plates, parameres and sub-genital plates not developed.

Remarks.—The above genitalia are on an entirely different plan from those in Psylloideae. In the form of the aedeagus, this family is the most primitive of all Rhynchota. In the absence of the parameres and sub-genital plates it comes near the Cicadidae. The absence of the basal plates, dechitinisation of the body segments, and their general form, etc. are specialisations. On the whole Coccidae, while having a primitive type of aedeagus, are highly specialised in the structure of the rest of the genitalia.

Remarks on Homoptera.

The genitalia in this sub-order are distinguished from those in Heteroptera by (i) the position of the basal plates, which do not surround the basal foramen, but lie on the internal surface of the segmental membrane inside the body cavity; (ii) the general form and position of the aedeagus, originating from near the base of the Xth segment; (iii) the complete absence of a distinct genital chamber and its accessories, *e.g.* inferior process, etc.; (iv) the position of the parameres whose bases are always in actual contact with the basal plates; (v) the development of the XIth segment and the anal style; (vi) the presence of the sub-genital plates in most families.

Within the sub-order three types of the genitalia can be made out :—

A. Aedeagus wholly permanently exposed. Parameres and the sub-genital plates not developed. Basal plates large and well developed. Rudiments of the basal-plates bridge present. The Xth segment enormously elongated

in the posterior ventral region, the anal opening on the dorsal side. Found in Cicadidae. Coccidae come near this, but are specialised in the total reduction of the basal plates, etc.

B. Aedeagus wholly exposed. Parameres and the sub-genital plates well developed. Basal plates short without a bridge. The Xth segment small. Met with in Membracidae, Cercopidae and Jassidae.

C. Aedeagus with only its extreme distal region invaginable, or differentiated into distinct phallosoma, conjunctiva, vesica, etc. Parameres present, but the sub-genital plates almost not developed. Basal plates extremely short, with, however, a very long prolongation; their bridge well developed. The Xth segment as in *A*. Met with in Fulgoroideae and Psylloideae.

Of the above, the type *A* (Cicadidae) seems to contain the greatest number of primitive features. Type *B* (Membracidae, Cercopidae and Jassidae) comes nearer this primitive type, while Fulgoroidea, etc. (type *C*) seem to have diverged from it at a very early stage, before the evolution of the sub-genital plates in the Homoptera series.

As Psylloideae have the same type as Fulgoroideae (p. 214) and Coccidae somewhat resemble Cicadidae, so division of the sub-order Homoptera into Sternorhyncha and Auchenorhyncha is not supported by the structure of the genitalia.

Comparison of Homoptera and Heteroptera.

Cicadidae resemble Heteroptera in the form of the VIIIth segment, and in the non-differentiation of the sub-genital plates; the Fulgoroideae also have no sub-genital plates, and, moreover, show different grades of aedeagus differentiation parallel to those in Heteroptera. (Still more, most Fulgoroideae, unlike the rest of Homoptera, resemble Heteroptera in not having a complete ovipositor.)

But the structure and the position of the basal plates, surrounding the basal foramen or lying on the segmental membrane inside the body cavity, separate the two sub-orders quite distinctly without any exception. It seems that the heteropterous condition is more primitive, but this cannot be asserted with any certainty unless any informa-

tion about the condition of the basal plates in other orders of insects is available.

Thus the two sub-orders seem to have a common origin, and are not distinct orders as suggested by some; but they are separated by a good gap, and we must look to Palaeontology for some protohemiptera in which the basal plates are in the intermediate condition.

The above relationships can be diagrammatically expressed as follows :—

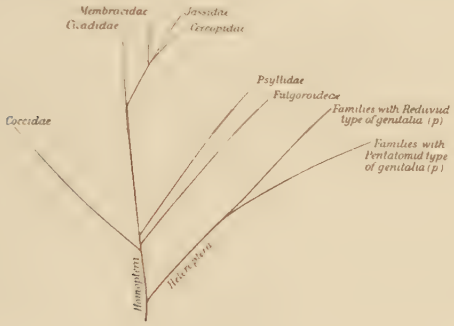


Fig. 3.

VII. GENERAL MORPHOLOGY AND SUMMARY.

(a) *Terminal Abdominal Segments.*

While in the adult Heteroptera only ten abdominal segments can be made out, the anus being at the distal extremity of the Xth, in Homoptera several additional sclerites are found between the latter segment and the anal opening. In the Cicadidae and Fulgoroideae these sclerites consist of two large conical pieces, one above, the other below the anus (the latter piece being the anal style), and two very small ones in the lateral regions, one on each side. In most Cercopidae and Jassidae, the sclerites occur as forming a complete ring behind the Xth, and another small piece and the anal style being still present beyond the ring. Therefore, it is not very difficult to assume that in Homoptera there are at least eleven segments, with an additional sclerite —the anal style —and I have provisionally labelled the parts as such. Whether the anal style, often a spoon-like structure, with a median line of weakness and prominent hairs on the borders,

represents the fused " cerci " of the Orthopteroid Insects, or the " telson " of Heymons, is beyond the scope of the present investigation.

The segments beyond the VIIth are associated with the genitalia. They do not show distinct tergites and sternites, and while almost visible and exposed in Homoptera, are retracted within the preceding segments in Heteroptera. The VIIIth segments in the latter sub-order, often well chitinised only in the ventral region is closely set on the base of the IXth. In the Cicadidae alone, amongst Homoptera, the VIIIth shows this condition, it is even more prolonged posteriorly, forming a " hypandrium." In most aquatic Heteroptera, the pleurites of this segment are produced in the posterior direction as appendage-like processes, especially well marked in the Belostomidae and Nepidae, in the latter, the prolongations by approximation with each other forming the " respiratory siphon."

The IXth, bearing all the genitalia, is highly modified. It is the largest of the abdominal segments; comparatively shorter dorsally, it is enormously enlarged in the lateral regions, especially in Homoptera. The ventral or the sternal part of the IXth is very large in Heteroptera, projecting much beyond the dorsal or the lateral regions, but is extremely short in most Homoptera, where it bears a pair of large appendages—the sub-genital appendages—at its posterior margin. Moreover, in the latter group, this segment, as a whole, is oblique in disposition, *i.e.* the line passing through its tergite and sternite does not meet the median axis at right angles.

The Xth segment being extremely small, the intersegmental membrane between this and the IXth—the segmental membrane—is very large. The genital organ proper (aedeagus) originates from the ventral region of this area, near the posterior margin of the IXth sternite. Owing to the oblique position of the IXth segment in most Homoptera (Cicadoideae), as above explained, the segmental membrane instead of being vertical, faces the ventral side. This feature has been the cause of a considerable amount of confusion, many investigators having interpreted the segmental membrane as the dechitinised IXth sternite, the IXth sternite proper, which as above mentioned, is very small in this group, having been ignored. But this is a matter certainly of no small significance to the students of morphology, because if the segmental membrane

is the IXth sternite, the genital organ which originates from its ventral, topographically anterior region (due to the above obliquity), so to speak, originates from between the VIIIth and IXth sternite and not IXth and Xth. Muir has not definitely declared the area under discussion as the IXth sternite, but from his clear and distinct statement that the male gonopore in Homoptera is between the VIIIth and IXth abdominal sternite, it is undoubtedly implied that it is so. Moreover, he has not altogether ignored the IXth sternite proper, but believes it, along with the sub-genital plates, to be the coxites of the VIIIth sternite, "*let loose and amalgamated with the ninth segment during ontogeny.*" (Italics mine.) This looks like a morphological paradox; at least so far as the literature available shows, no such shifting has been described in any other group of insects. If such an event were to occur in order to bring a certain feature in a particular group in line with that in insects in general, one might believe it, but in Homoptera as a consequence of this the male gonopore is described as opening between the VIIIth and the IXth sternite, a feature unique in the Insecta. Muir is not unaware of this consequence. He writes (38): "In Diptera the male gonopore appears to open on the ninth sternite or between the ninth and tenth, *as it appears to do in most insects.* In Homoptera it appears to *open between the eighth and ninth*, etc., etc." (Italics mine.)

Muir therefore seems to believe that the IXth sternal region (what I have called) with the huge sub-genital plates in Membracidae and Cercopidae and the large sternite in Fulgoroideae are really part of the VIIIth sternite. In the previous pages I have made clear how the abdominal segments and the genitalia are homologous in the two sub-orders, therefore it follows that if the IXth sternite, etc. is really part of the VIIIth in Homoptera, it is of the same nature in Heteroptera. In the latter sub-order, as I have mentioned above, the IXth sternite is the largest region of the segment, naturally we expect some reduction in the VIIIth sternite, but, on the contrary, throughout the Heteroptera we find the VIIIth segment to be especially well developed in the sternal region. Moreover, Christophers and Cragg (11), who followed the development of these organs in *Cimex*, did not describe any shifting of a part of the VIIIth to the IXth.

It is interesting to settle the nature of the area behind

the VIIIth sternite and anterior to the base of the aedeagus in the Cicadidae, where, according to Muir, the coxites of the VIIIth segment do not amalgamate with the IXth : " the Cicadidae differ from all other Cicadoideae and Fulgoroideae in that the Coxites of the eighth sternite or ' g^1 ' are not incorporated into the pygofer (the ninth segment)—whereas in all other families they are." If the area in question is the IXth sternite, then his view that in Homoptera the gonopore opens between the VIIIth and IXth cannot hold good, and if the area is not the IXth sternite, then what can it be, in view of its position behind the VIIIth sternite?

Evidence from ontogeny should be very strong in morphological questions of the above nature. I have studied the development of the genitalia by examining the serial sections of the nymphs in different stages. Detailed results of the study will be communicated later on.* but what concerns the nature of the sub-genital plates may be given briefly here. Even in the young nymph of *Idiocerus* I find (Fig. 280) that these plates and the parameres originate from the same place, therefore if the genital plates are part of the VIIIth sternite, so are the parameres, but the fact that the parameres are the appendages of the IXth segment is not doubted by any investigator, even by Muir himself. And the fact that the sub-genital plates and parameres originate from the same place (in connection with the IXth) even in the young nymphs is of importance, as Kershaw and Muir describe the shifting of the plates from the VIIIth to the IXth as taking place in the last instar : " In the *last instar* (italics mine) . . . ' g^1 ' (sub-genital plates) are not in such close connection with the eighth sternite " (p. 204). Such delicate origins can be best made out by cutting sections, which Kershaw and Muir seem not to have done.

As already pointed out, the sub-genital plates are generally present where the IXth sternite itself is small, *e.g.* Jassidae, etc., and they are often (Membracidae, etc.) of the same consistency as, and continuous with, the sternite; therefore it is logical to conclude that the plates are nothing but the prolongations of the IXth sternite, probably representing its " coxites " (cf. Ephemeridae, sawflies, etc.).

(b) *Genitalia.*

The genitalia consist essentially of a median tubular

* See Q.J.M.S. 69, 1, 1924, p. 52.

organ, the aedeagus, and a pair of lateral appendages, the parameres, which are always in association with the base of the former.

Throughout the order the aedeagus is a sort of diverticulum or a backward continuation of the body wall between the IXth and Xth sternites, and, as shown above, not of that between the VIIIth and IXth, as is believed, especially in Homoptera, by authorities like Kershaw and Muir. At its distal extremity, the gonopore, the aedeagus is continuous with the ejaculatory duct, which at its proximal end is connected to the vasa deferentia, etc. The aedeagus and the ejaculatory duct together form the "azygotic portion of the genital tube" of Sharp and Muir, the former corresponding to the "eurozygotic," the latter to the "stenozygotic" part, the gonopore being the place of invagination of the two.

There seems nothing to indicate that any part (sternite, etc.) of a body segment takes part in the formation of the aedeagus in the sense in which they are supposed to do, for instance, in the case of Coleoptera * (Hopkins, Bugnion, etc.). This and the question whether the aedeagus is composed of a pair of appendages, subsequently amalgamated to form a tubular organ (Zander, 62, 63, 64, etc.) will be fully discussed in a subsequent communication dealing with the developmental history of the genitalia.

While in some Homoptera (Cicadoideae) the aedeagus is wholly exposed, in others (most Fulgorids) and all Heteroptera, due to differential chitinisation, its distal region is invaginated into the proximal. In the latter condition the aedeagus has been described as being differentiated into phallosoma and endosoma (cf. Coleoptera, where the aedeagus comprises "median lobe" and "internal sac"). Furthermore, while in some families, *e.g.* Reduviid group (Heteroptera), Cixiidae, Tettigometridae (Fulgorids), etc., only the above stage of aedeagus differentiation is reached, in others, *e.g.* Pentatomid group (Heteroptera), Ricaniidae, etc. (Fulgorids), the endosoma is again differentiated into conjunctiva and vesica, the junction of the two being in contact with the ejaculatory duct inside.

The conjunctiva is often produced into a varying number of diverticula, subsequently solidified and appearing as

* Since this was written I have shown that in the case of the Coleoptera also no part of a body segment is involved in the formation of the aedeagus, etc. (see P.Z.S., 1924, p. 857).

distinct solid appendages. Rarely the vesica also shows this character, *e.g.* Capsidae.

The ejaculatory duct, as well, undergoes some interesting modifications, especially in the Pentatomid group, where it expands into a large rounded structure—the ejaculatory reservoir—at the base of the vesica, and is extraordinarily thick-walled during its course within the latter organ.

Basal plates are present in all the families with the exception of Coccidae. In the Heteroptera they lie in the lateral borders of the basal foramen, simply meeting (Pentatomid group) or fused with (Reduviid group) each other in the median ventral line. Their dorsal free ends are connected with the bases of the parameres by means of muscles and chitinous ligaments. In the Homoptera, as explained in detail in the account of the Cicadidae, they lie on the internal surface of the segmental membrane, within the body cavity. Their free ends are in direct contact with the parameres. In the different Homopterous families, the basal plates show great modifications.

To the basal plates are attached powerful muscles, which govern the movements of the aedeagus. At the junction of the plates there is often present a ∩-shaped structure, the basal-plates bridge, especially well marked in the Pentatomid group. The arms of the bridge are prolonged into a pair of ligaments, *e.g.* Pentatomidae, or struts, *e.g.* Reduviidae, Nepidae, etc., which at the other end are fused to the base of the endosoma or vesica. In most Homoptera the bridge is indistinguishable, but in Fulgoroideae it is extraordinarily well developed and forms a sheath round the ejaculatory duct till the latter enters the vesica.

The basal plates have not so far been recognised as a structure of regular occurrence in the insect genitalia. But it is highly probable that they are so, because wherever the genitalia have been studied in detail, a single or a pair of chitinous pieces, forming bases for the attachment of strong muscles, have been found at the base of the aedeagus, *e.g.* "median struts" or the "basal piece" itself in Coleoptera (Sharp and Muir), "basal plate" in *Pediculus* (Nuttall, 42), "Penis Fortsatz" in Hymenoptera, Trichoptera and Lepidoptera (Zander), "basal plates" in Diptera (Edwards and Christophers), "endoapophyses," etc., in Orthoptera (Walker), etc. With the aid of the fundamental morphological relations which I have established above

for the basal plates, it is hoped that future investigators in the different Insect Orders will easily discover the homologue of these plates.

Parameres, the lateral appendages, are present in all the families except Coccidae and Cicadidae. In one Cicadid, *Tettigarcta ciliata*, which was sent to me by Mr. Muir, there is, however, a pair of appendages that look like parameres. But I am unable to agree to the suggestion of Kershaw and Muir that the conical diverticula of the postero-ventral region of the IXth segment, developed in most Cicadidae, represent the parameres. These diverticula, apart from not being distinct appendages, have no connection with the basal plates, as the parameres have in other families and in the Cicadid *Tettigarcta* above referred to.

Very recently, Crampton (10) has suggested that parameres (his "gonostyli") in Fulgoroideae are the sub-genital plates (his "hypandrium valves"). This is obviously a wrong interpretation, as in this group the relations of the parameres to the rest of the genitalia are not at all modified. Probably Crampton has been led astray on account of their large size.

Crampton has made another suggestion with which I cannot agree, *i.e.* that the parameres or "the gonostyli" in Rhynchota are homologous to the "styles" in Cockroaches (Orthoptera). As at the present stage, I intend to avoid, purposely, the comparing of the Rhynchotan genitalia with those in other orders, I simply mention the fact that, as is evident from the extensive works of Walker and Chopard, the "styles" in Orthoptera are at the posterior margin of the IXth sternite, while the parameres in Rhynchota are at an entirely different place, connected to the base and lying on the sides of the aedeagus. Moreover, Walker has described in several Orthopteroid groups a pair of appendages, "parameres" distinct from "styles" and exactly in the same position as parameres in Rhynchota. Therefore, if there are any homologues of parameres in Orthoptera, they are these appendages.

VIII. MECHANISM AND FUNCTION.

The whole of the aedeagus (Homoptera) or only its distal region, versica (Heteroptera), functions as the intromittent organ. The powerful muscles, protractors (Fig. 278, pr) and retractors (re), attached to the dorsal and ventral

regions, respectively, of the basal plates are responsible for the eversion and retraction of the aedeagus. The similar movements of the endosoma or the vesica are brought about by the inflow or outflow of the body fluid, though the muscles and ligaments originating from the region of the basal-plates bridge and attached to the base of the vesica, also render some assistance in this connection.

The spermatheca in the female reproductive organs is set apart for the storage of the spermatozoa. In Rhynchota this organ is often a small, bag-like receptacle connected to the uterus by means of a narrow duct of a varying length. Opinions differ as to whether the spermatozoa are put in any part of the oviduct whence they subsequently travel into the spermatheca, or whether they are conveyed directly to the latter organ in the first instance. The latter condition seems generally to prevail, as wherever the female organs have been examined there seems to be a definite relation between the size of the vesica and that of the spermathecal duct. For instance, in the Lygaeid form, which has been figured in copula (Fig. 278), the vesica is extremely elongated and flagellum-like, the duct is also proportionately very long, and the apex of the vesica can be seen near the mouth of the spermatheca.

To reach a destination by such a circuitous route as that in the above case, the vesica must be penetrative and at the same time flexible. This is provided for by the thick-walled ejaculatory duct within, whose spiral lining also allows of the bending and twisting necessary for the purpose. In families like Nepidae and Corixidae, where the vesica is not stiff, the keel-like distal region of the phallosoma in the former (Fig. 126) and the posteriorly produced IXth sternite in the latter (Fig. 131) are penetrative and carry the vesica inside the female parts. In Cimicidae and Pelogonidae the paramere of one side does the same. In Reduviidae, Notonectidae, etc., where a vesica is not differentiated, the turgidity resulting from the inflow of the body fluid gives the necessary power to the endosoma. In Homoptera (Fig. 279) the spermatheca is very near the uterus and the setiform aedeagus reaches the organ directly.

The grip of the aedeagus inside the female organs is afforded principally by the conjunctiva or vesica appendages which, pointing towards the aedeagus apex in the state of rest, point towards its base when the conjunctiva, etc. are

everted. By pulling out or pushing in the conjunctiva one can easily see how the appendages gradually change their direction. The turgidity of the everted parts is in itself very helpful in the above process. This turgidity seems to be functional at its best in some Fulgorids, where the phallosoma is membranous and large, and with the inflow of the body fluid assumes the form of two laterally directed turgid bags (Figs. 242, 243).

The parameres seem to be the dynamic centre of the copulation mechanism. They are almost always protruding beyond the rest of the genitalia and at their bases are connected with the basal plates, which, as already explained, are responsible for the eversion and retraction of the aedeagus. So it is highly probable that the hairs, etc., which are often present near their distal extremities, are sensory. Also, it appears (Figs. 278 and 279) that the parameres do operate to some extent in keeping apart the gonapophyses which hide the female gonopore, but the presence of strong muscles at the bases of the latter appendages show that the female is not altogether passive during copulation.

In most Fulgorids the parameres are leaf-like and seem to be principally for the protection of the aedeagus, the conjunctiva appendages, which are always protruding out, in that case serving to some extent the above functions of the parameres. In Cicadidae, where the parameres are altogether absent, their functions seem to have been taken up by the lobes in the postero-ventral region of the Xth segment, from between which the aedeagus protrudes. In no other Rhynchota does the Xth segment show this modification.

Such minute, delicate and sensitive organs as the genitalia, must be protected against any external injury. In Heteroptera, the IXth segment which bears them is always retracted within the preceding ones, the IXth sternite also is very large and the genitalia lie safe in the genital chamber. In Homoptera, where the IXth segment is exposed and the genital chamber is not distinct, there are different means of protection in the various families. In Membracidae, Cercopidae and Jassidae, the large sub-genital plates afford the needed protection. In Fulgoroideae, Psyllidae, etc., in the absence of the sub-genital plates, the expanded parameres and the flattened and enlarged Xth segment cover and protect the aedeagus.

In Cicadidae where the parameres are also absent, the aedeagus safely lodges in a groove on the ventral wall of the enlarged Xth segment, the VIIIth sternite, produced posteriorly, protecting it from below. In Coccidae, where all the agencies fail, the whole of the aedeagus is flexible and retracted within the body, the shelf-like basal strut affording an additional protection.

The sub-genital plates, besides acting as protective organs, seem to be concerned in keeping the "valve," a small leaf-like sclerite in front of the bases of the female gonapophyses in Jassidae, etc., out of the way of the aedeagus (Fig. 279).

The inferior process may be said to serve as a guide for the movements of the aedeagus, but its absence in most families indicates its relative insignificance.

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APPENDIX.

The following is the taxonomic arrangement actually followed in the preceding pages; as stated before, it is mainly that of Oshanin (1916), but with some modifications.

Sub-order *HETEROPTERA*.

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Explanation of Plates VI–XXXII.

Lettering.

aed	.	aedeagus.
aed.b.st	.	aedeagus basal support.
a	.	anus.
as	.	anal style.
bf	.	basal foramen.
bp	.	basal plates.
bp.br	.	basal-plates bridge.
bp.pr	.	,, prolongation.
cnj	.	conjunctiva.
cnj app$^{1-3}$		different conjunctiva appendages.
ejd	.	ejaculatory duct.
ejr	.	,, reservoir.
ends	.	endosoma.
gc	.	genital chamber.
gnp	.	gonopore.
gp	.	sub-genital plates.
hp	.	hypandrium.
inf	.	inferior process.
pr	.	parameres.
peri	.	periandrium.
phs	.	phallosoma.
phs.mth	.	phallosoma mouth.
pgr	.	pygofers.
sm	.	segmental membrane.
vs	.	vesica.
vs.app	.	vesica appendages.
I–XI	.	respective abdominal segments.
Ip–XIp	.	pleurites of the abdominal segments.
Is–XIs	.	sternites of the abdominal segments.
It–XIt	.	tergites of the abdominal segments.

For the method of drawing see p. 130 (Technique and Methods). As stated there, most of the figures represent the parts as seen from the left side in the case of Heteroptera and from the right in Homoptera, except where otherwise stated.

(N.B.—The magnifications of figures are given below.)

PLATE VI.

FIG. 1. Heteropterous type of genitalia. Lateral view (left). Aedeagus fully everted. Diagrammatic.
2. Heteropterous type of genitalia. Dorsal view. IXth tergum and Xth segment removed.
3. Homopterous type of genitalia. Lateral view (left). Diagrammatic.

PLATE VII.

(PENTATOMOIDEAE.)

4. *Coptosoma cribrarium.* Lateral view. Left conjunctiva appendage No. 2 not figured. × 65.
5. *Brachyplatys pusillus.* Lateral view. × 65.
6. *Geotomus* sp. Lateral view. × 65.
7. *Sehirus* sp. ,, ,,
8. *Picromerus bidens.* ,, ,,
9. *Stiretrus anchorago.* Lateral view. × 65; pr × 45.
10. *Cantao ocellatus.* ,, × 25.
11. *Philia (Lampromicra) senator.* Lateral view. × 35.
12. *Scutellera nobilis.* ,, ,,
13. *Chrysocoris stockerus.* ,, ,,
14. *Graphosoma lineatum.* Lateral view. × 65; pr × 35.
15. *Podops inuncta.* Dorsal view. × 65.

PLATE VIII.

(PENTATOMOIDEAE, *cont.*)

16. *Nezara viridula.* Lateral view. × 65.
17. ,, *graminea.* Ventral view. ,, ; pr × 45.
18. *Piezodorus lituratus.* ,, × 45.
19. *Catacanthus incornatus.* A. Lateral view. × 35. B. Ventral view, distal region.
20. *Tropicoris rufipes.* Surface view. × 45.
21. *Bagrada picta.* Lateral view. × 50.
22. *Dolycoris baccarum.* Surface view. × 35.
23. *Carpocoris nigricornis.* Lateral view. × 50.
24. *Dalpada oculata.* Surface view. × 45.
25. *Acanthosoma haemorrhoidale.* A. Dorso-lateral view. × 35. B. Horizontal longitudinal section. Diagrammatic.

PLATE IX.

(Pentatomoideae, *concld.* Coreidae.)

Fig. 26. *Urochela quadripunctata.* Lateral view. × 65; pr × 35.
27. *Aspongopus janus.* „ × 45; pr × 25.
28. *Megarhynchus rostratus.* Surface view. × 50; pr × 35.
29. *Tessaratoma* sp. (probably *javanica*). Lateral view. × 30.
30. *Eusthenes pratti.* „ × 20.
31. *Sepina seychellensis.* „ × 45.
32. *Hirilcus alternatus.* Lateral view. × 45.
33. *Homoeocerus inornatus.* Lateral view. × 65.
34. „ *rosaceus.* Surface view, with IXth segment. × 25.

PLATE X.

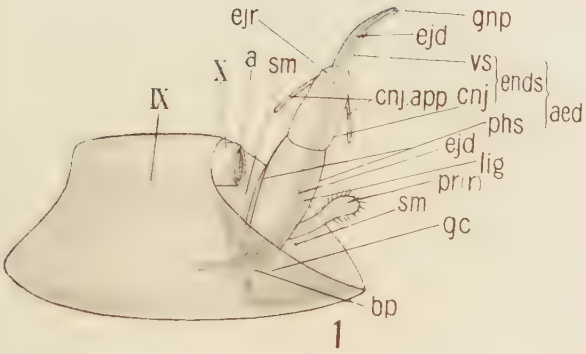
(Coreidae *concld.* Aradoideae, Berytidae.)

35. *Leptoglossus membranaceus.* Surface view, Phallosoma cut open. × 25.
36. *Cletus stâli.* Surface view, with IXth segment. × 25.
37. *Clavigralla gibbosa.* Surface view. × 60.
38. *Stenocephalus agilis.* „ × 50.
39. *Riptortus linearis.* Lateral view. × 40.
40. *Leptocorisa varicornis.* Surface view. × 40.
41. *Corizus scotti.* „ × 65.
42. *Serinetha* sp. „ × 45.
43. *Aradus depressus.* Lateral view. × 120.
44. *Mezira membranacea.* Lateral view. × 65.
45. *Aneurus laevis.* Surface view. × 120.
46. *Berytus minor.* A. Lateral view, aedeagus. × 65. B. Dorsal view, IXth segment with parameres *in situ.* × 50.

PLATE XI.

(Berytidae *concld.* Colobathristid, Lygaeidae.)

47. *Hubertiella cardamomi.* A. Lateral view, aedeagus. × 65. B. Dorsal view, IXth segment with parameres *in situ.* × 50.
48. *Phaenacantha australiae.* Lateral view. × 65.
49. *Lygaeus militaris* (= *Spilostethus pandurus* var. *militaris* Osh. Cat.). Surface view. × 45.
50. *Graptostethus servus.* Dorso-lateral view; basal plates dissected apart. × 65.



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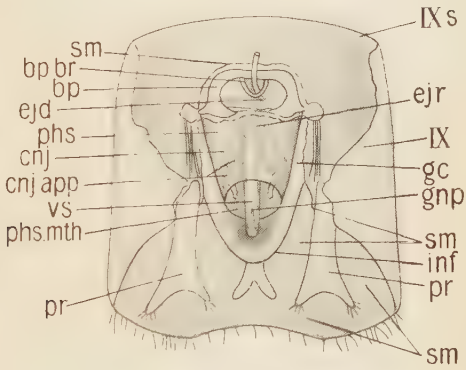

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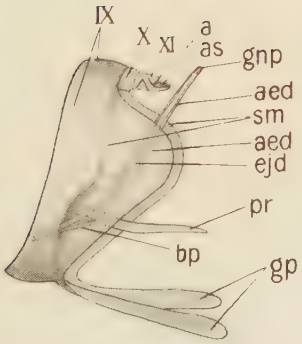

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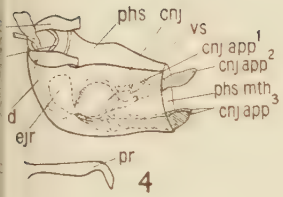
H. S-P., del. *Vaus & Crampton, Ltd.*

GENITALIA OF RHYNCHOTA.



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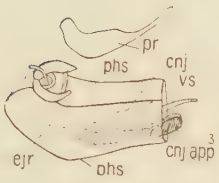

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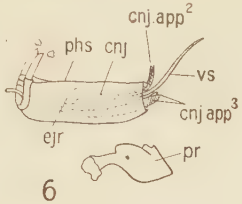

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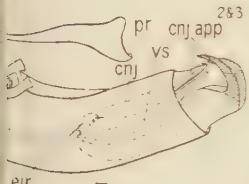

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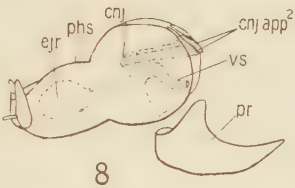

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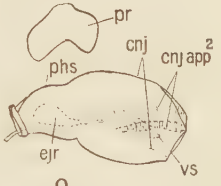

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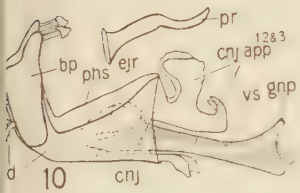

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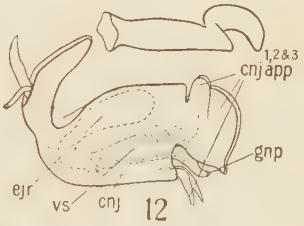

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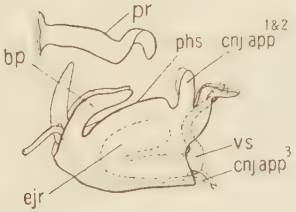

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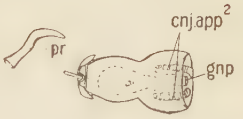

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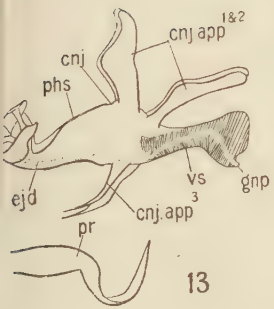

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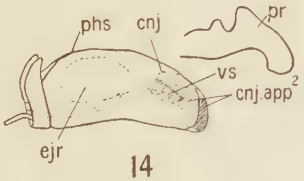

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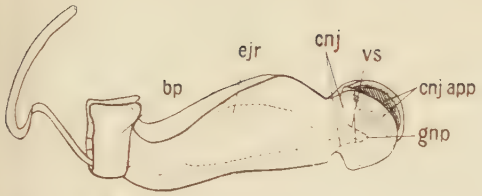

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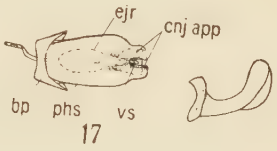

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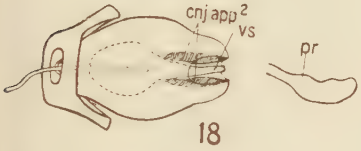

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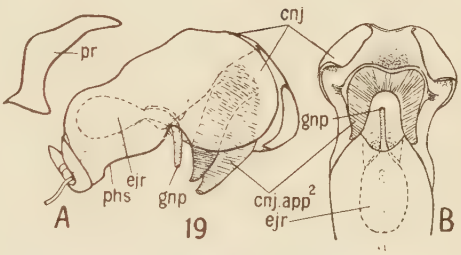

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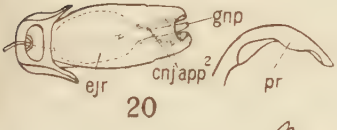

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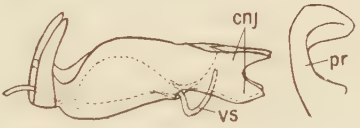

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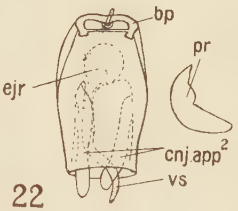

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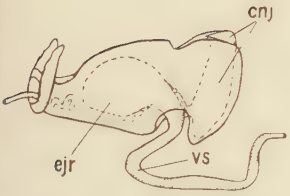

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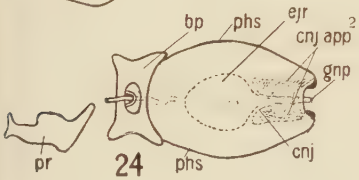

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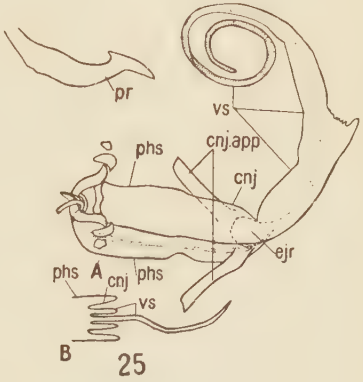

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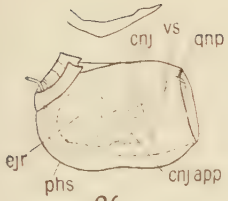

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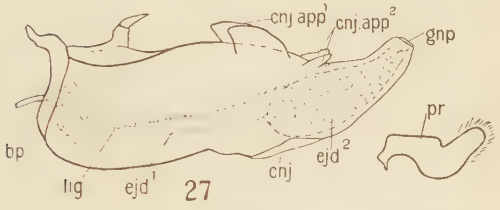

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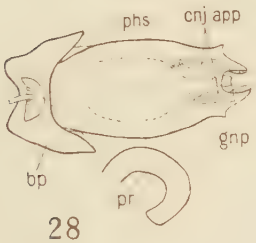

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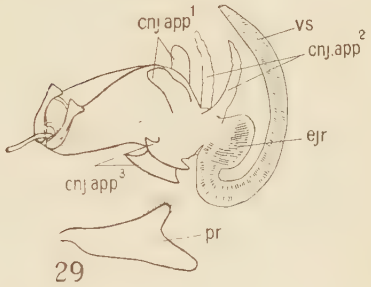

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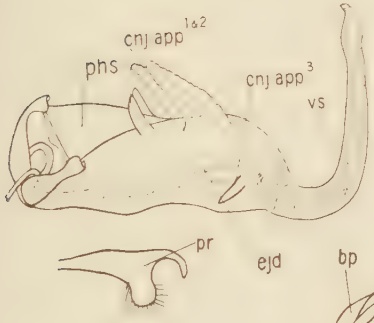

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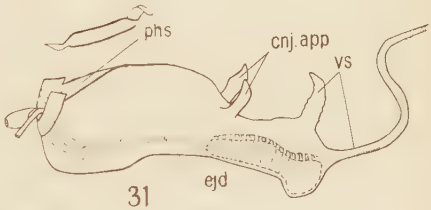

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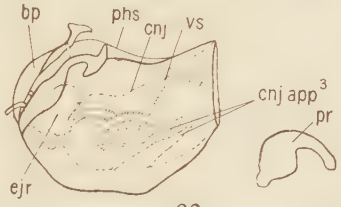

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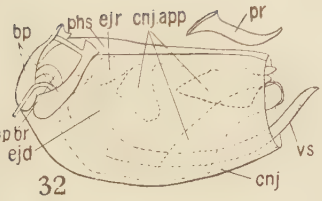

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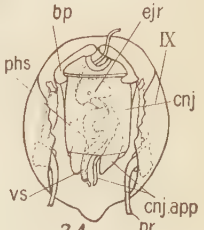

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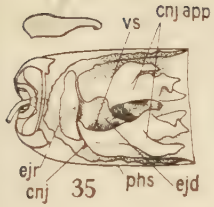

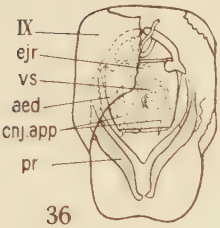

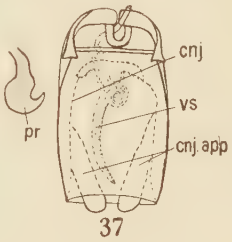

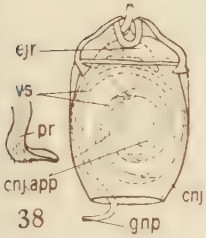

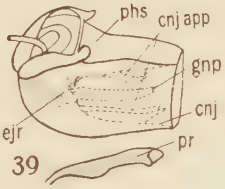

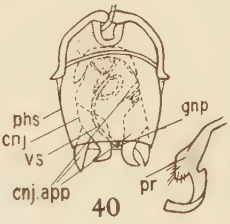

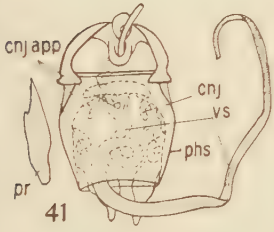

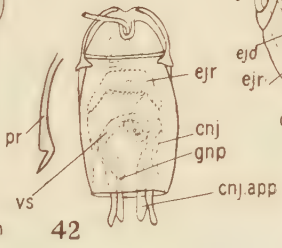

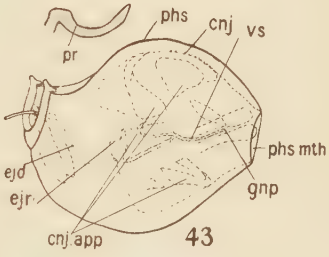

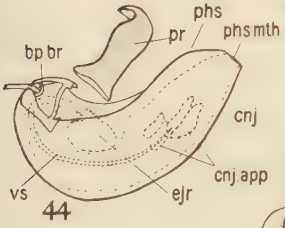

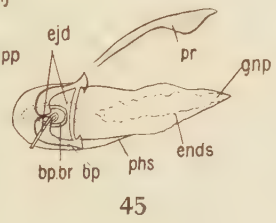

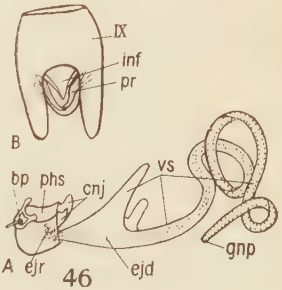

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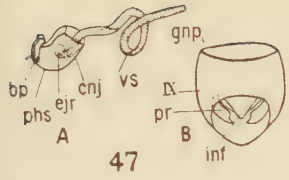

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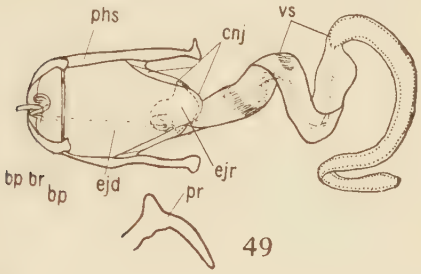

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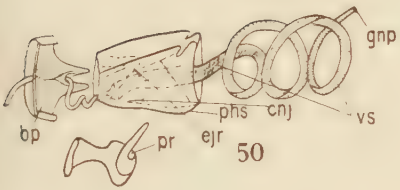

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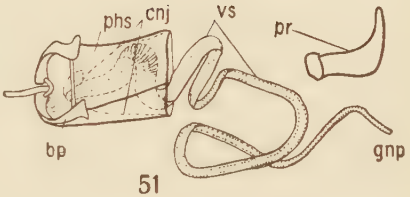

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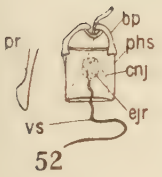

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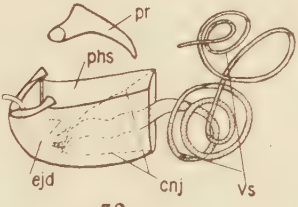

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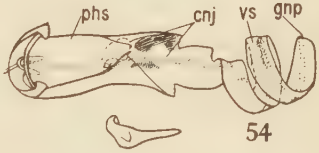

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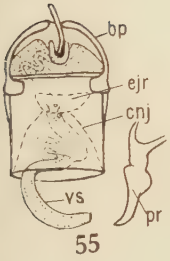

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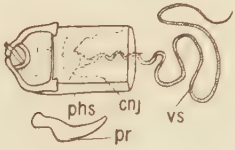

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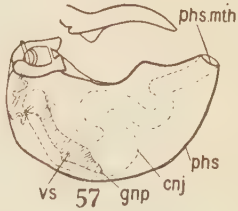

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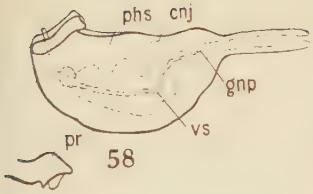

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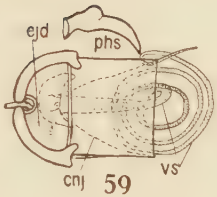

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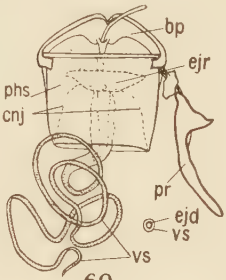

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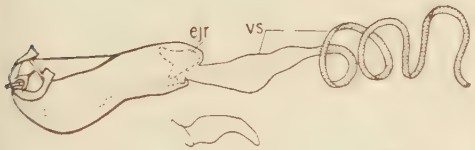

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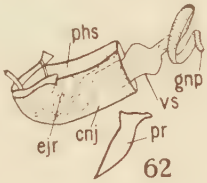

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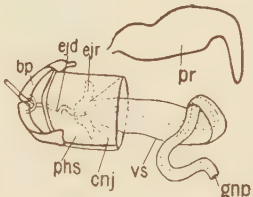

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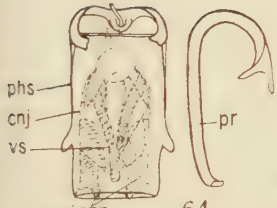

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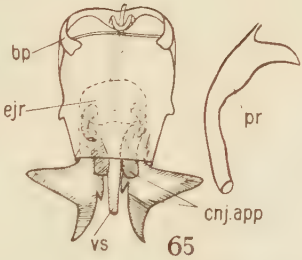

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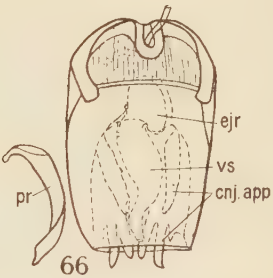

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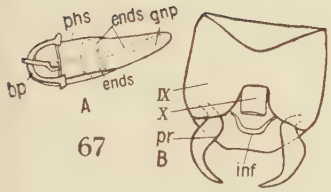

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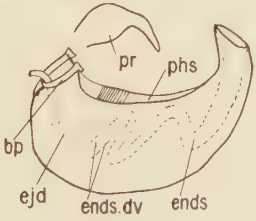

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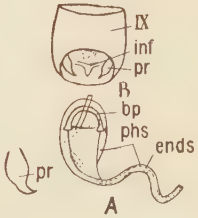

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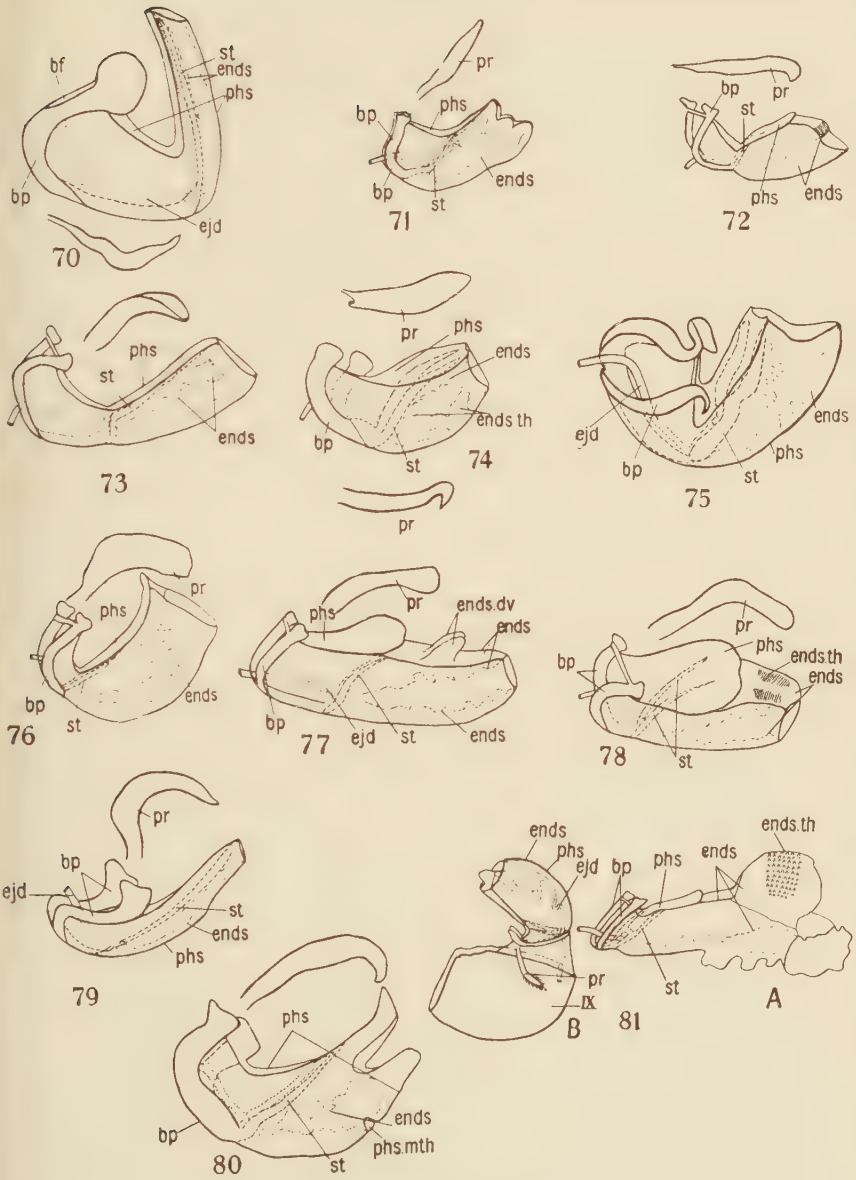

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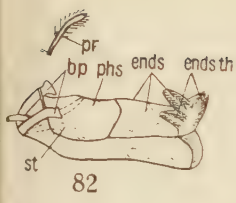

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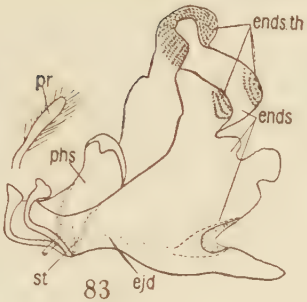

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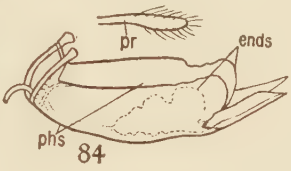

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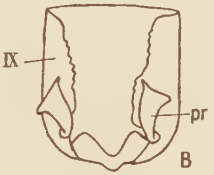

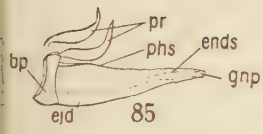

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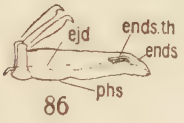

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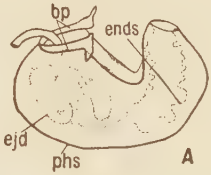

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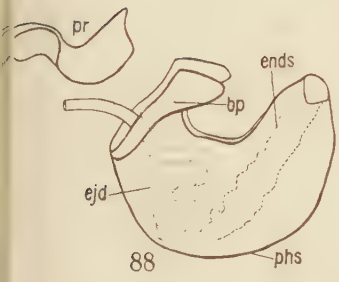

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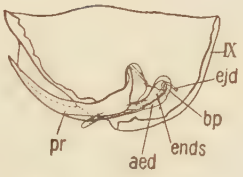

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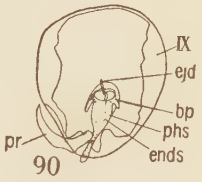

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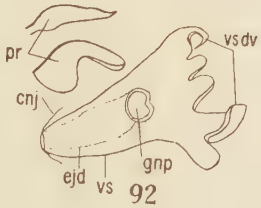

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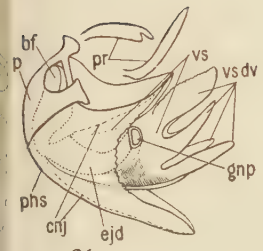

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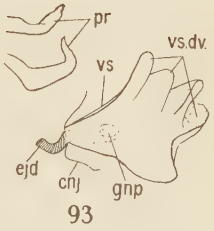

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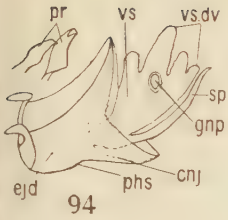

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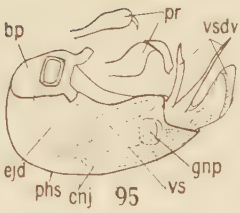

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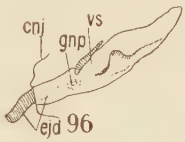

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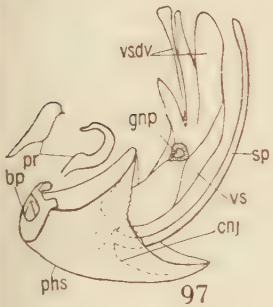

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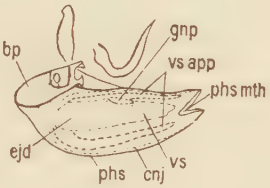

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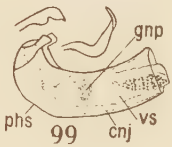

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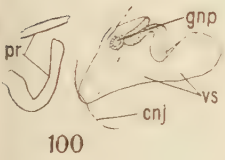

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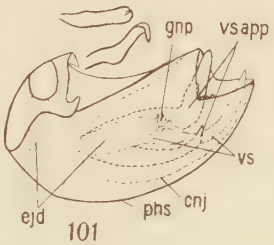

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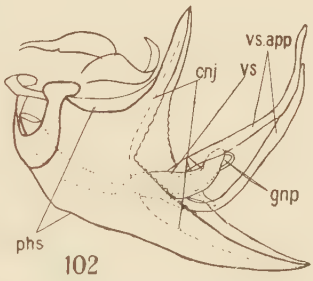

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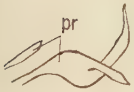

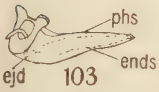

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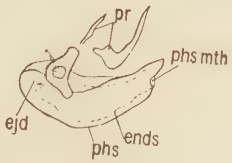

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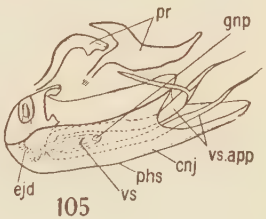

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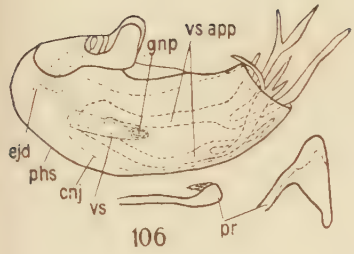

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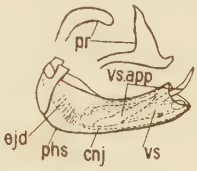

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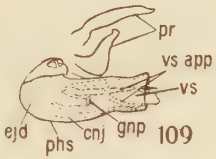

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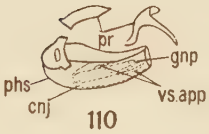

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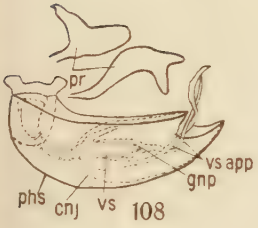

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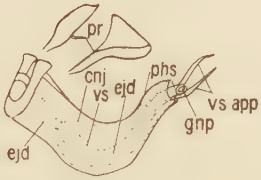

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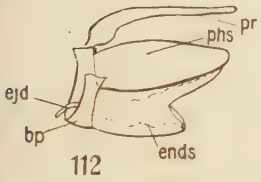

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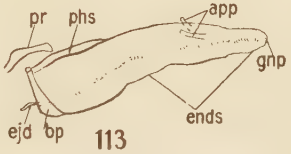

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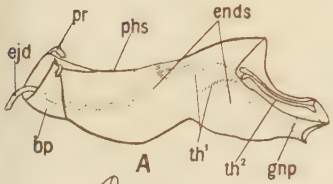

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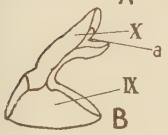

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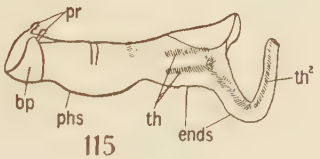

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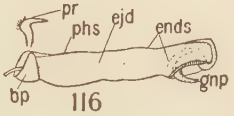

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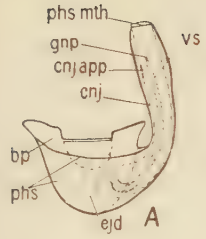

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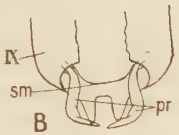

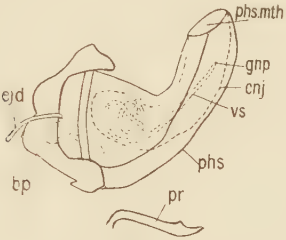

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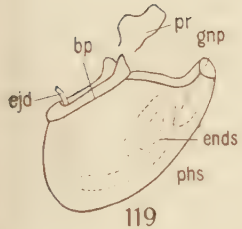

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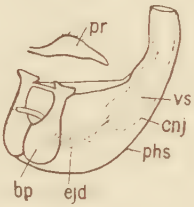

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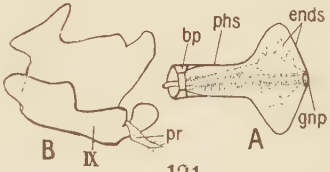

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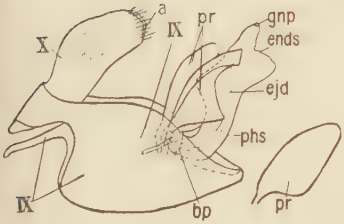

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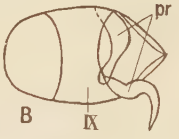

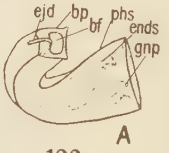

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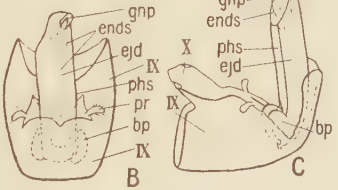

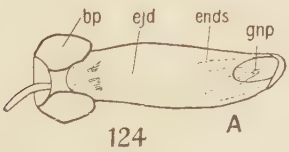

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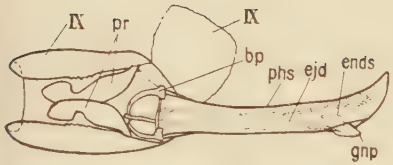

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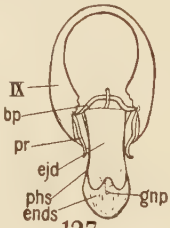

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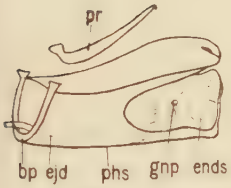

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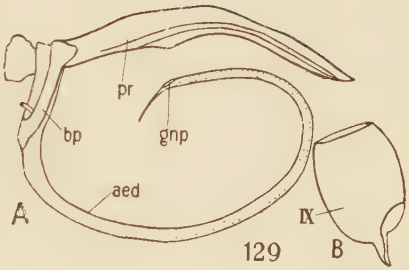

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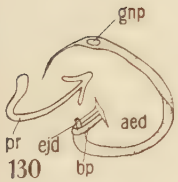

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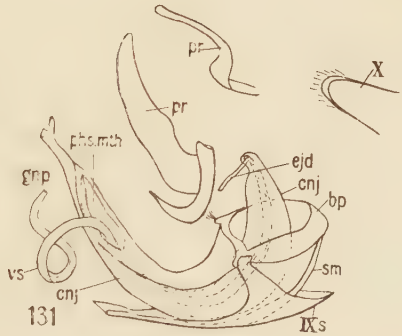

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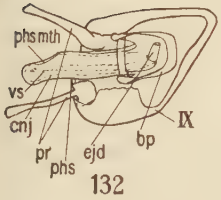

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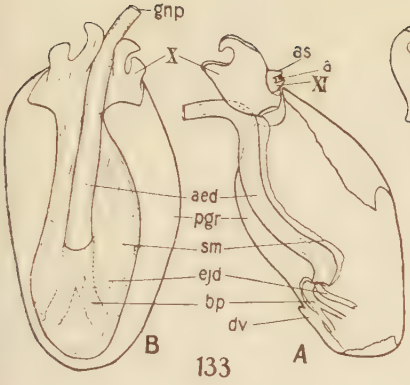

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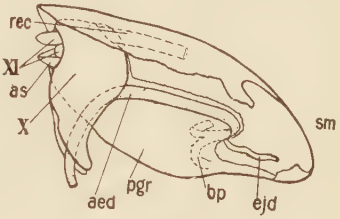

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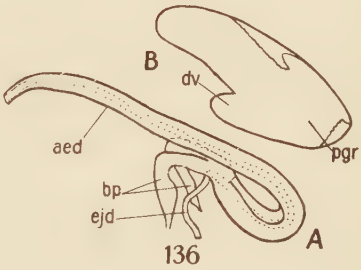

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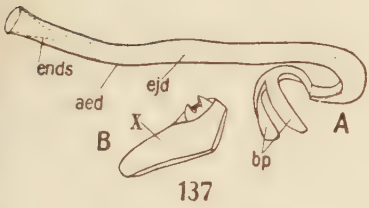

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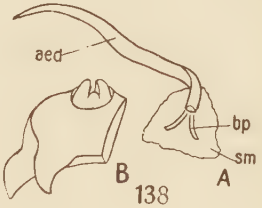

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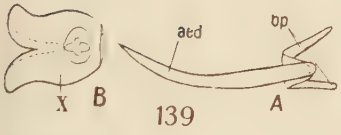

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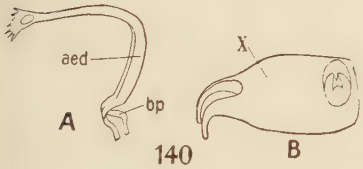

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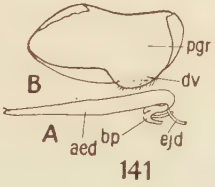

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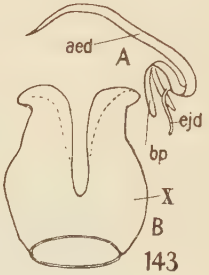

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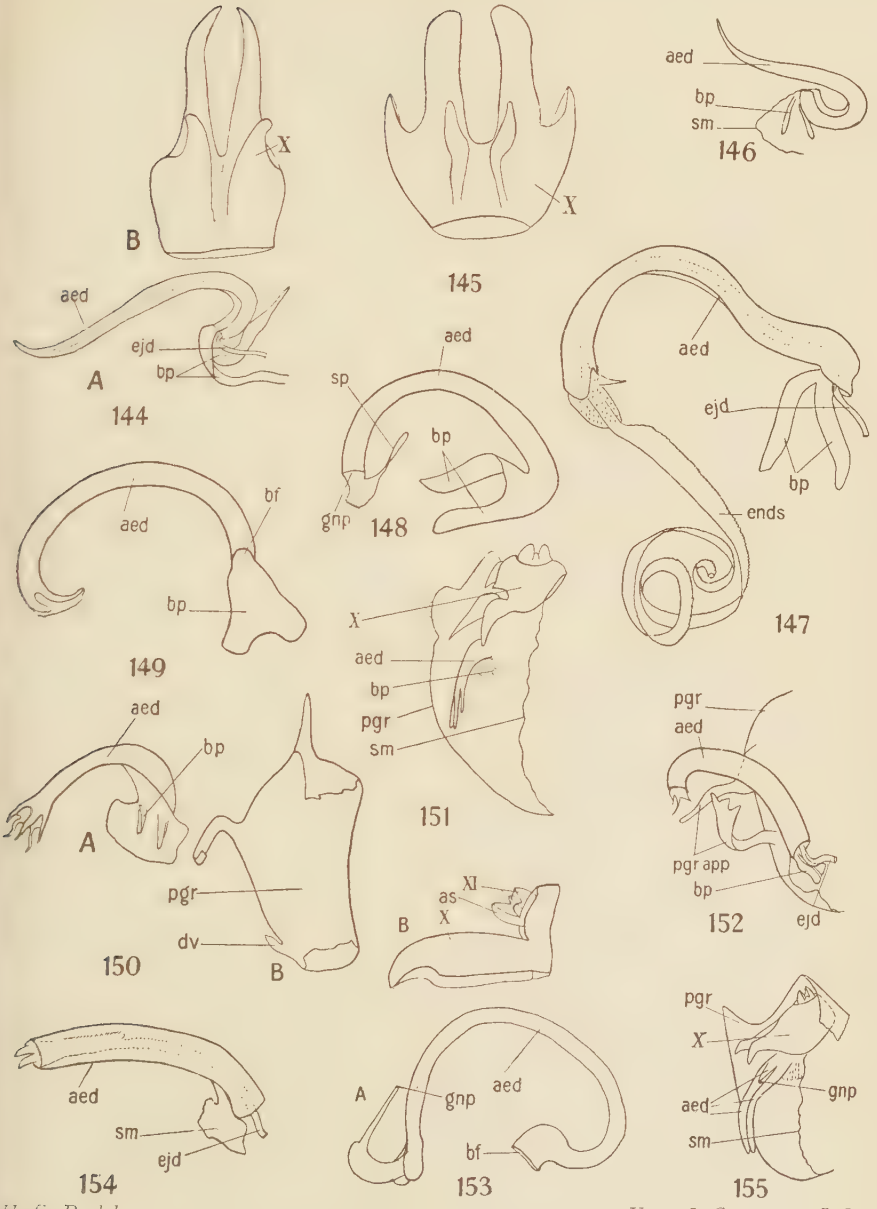

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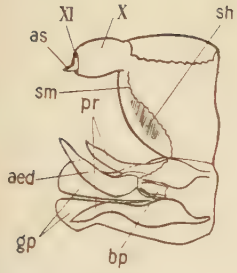

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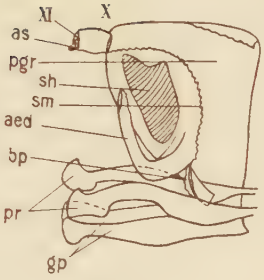

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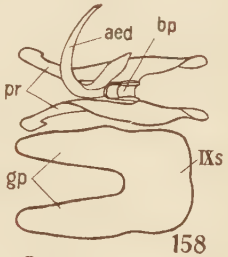

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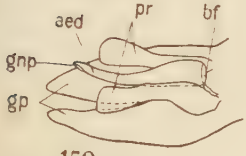

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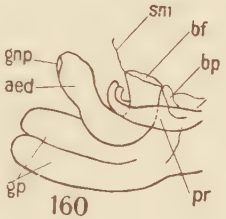

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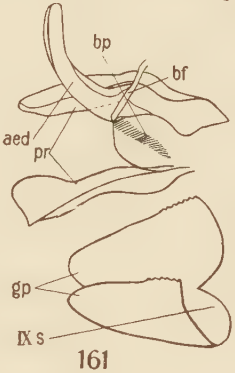

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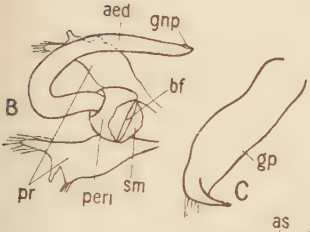

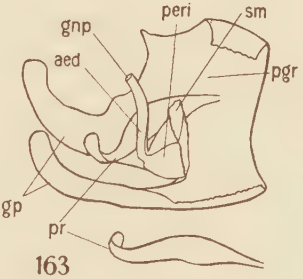

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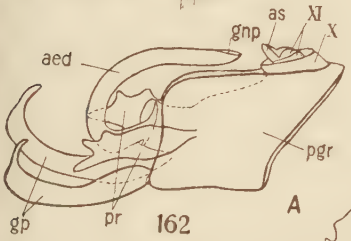

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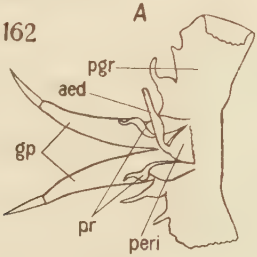

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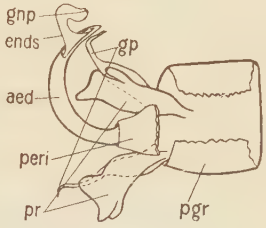

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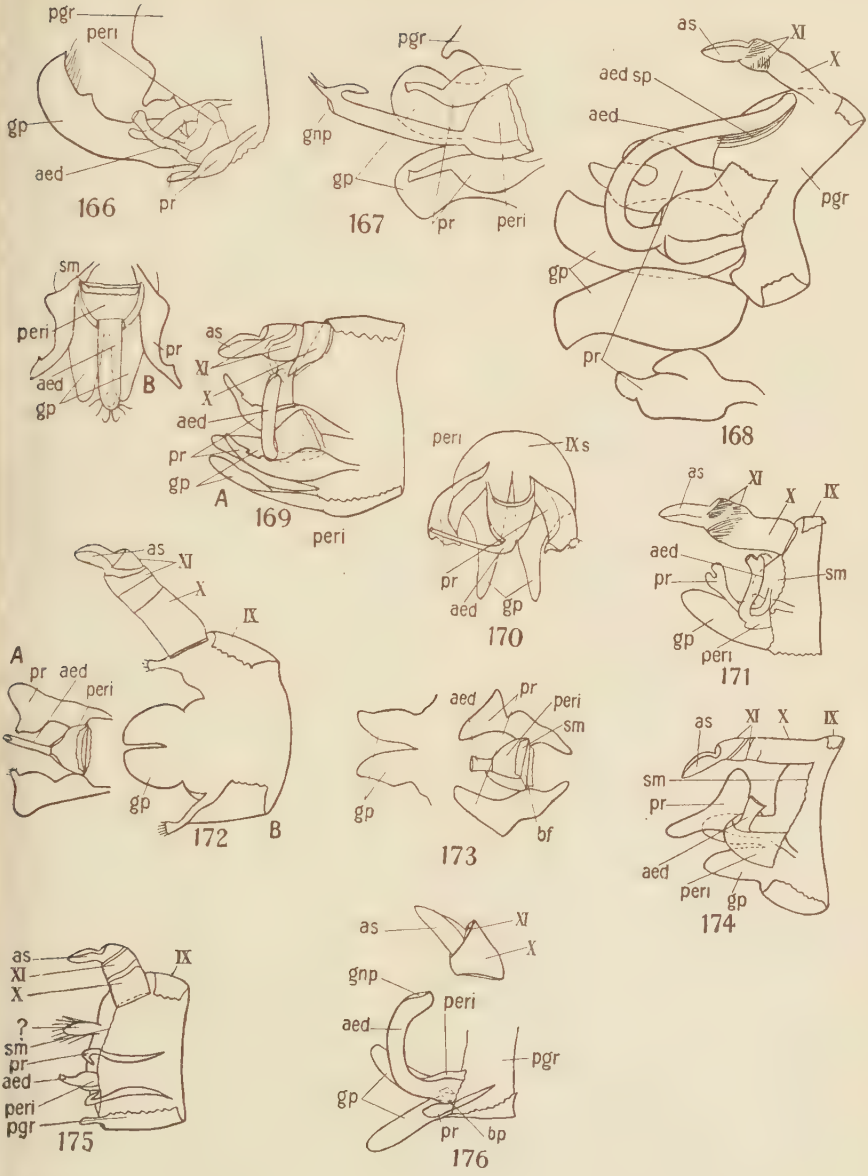

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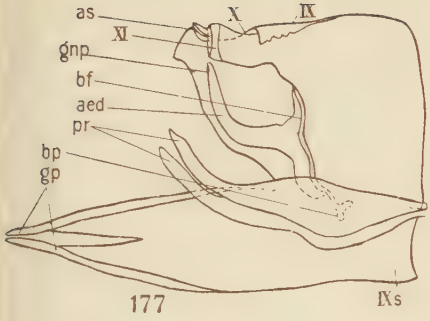

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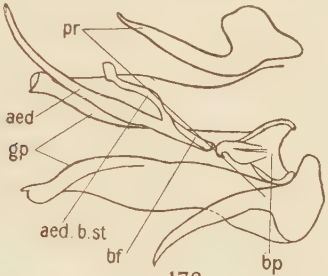

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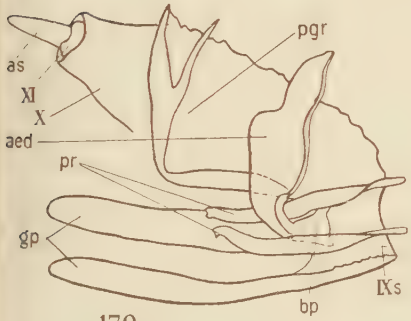

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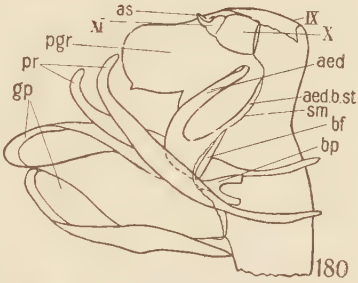

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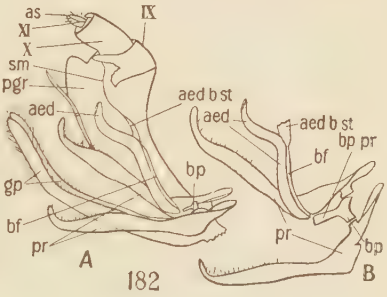

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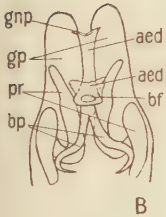

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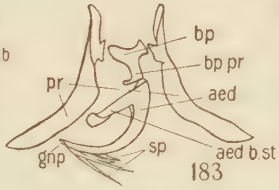

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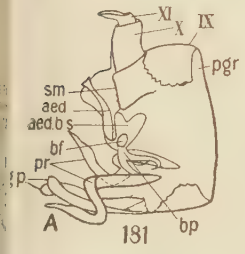

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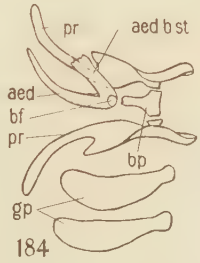

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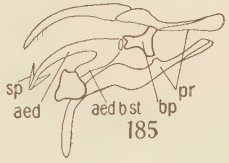

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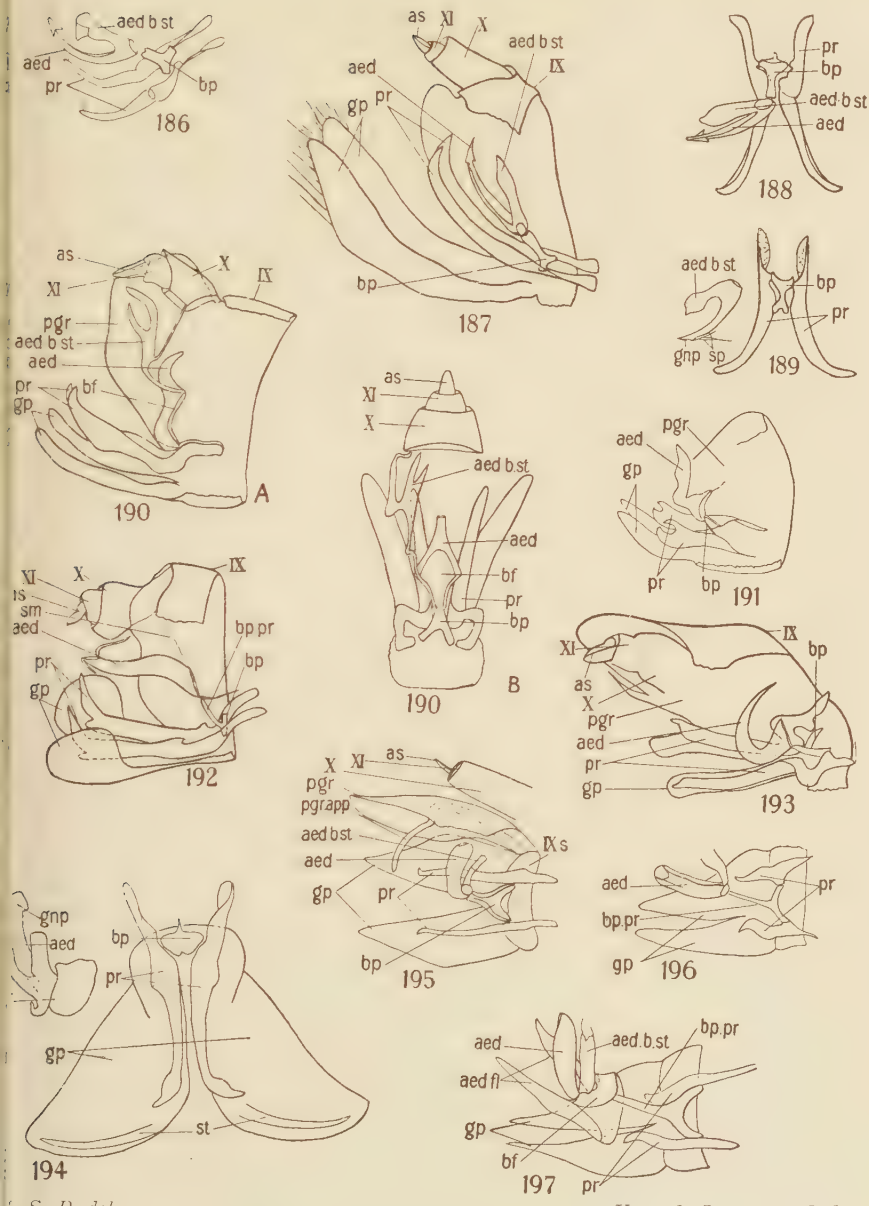

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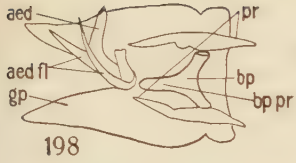

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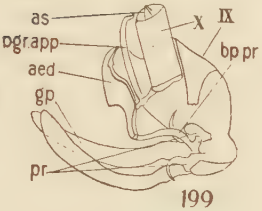

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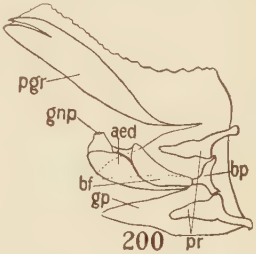

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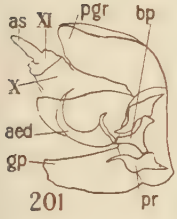

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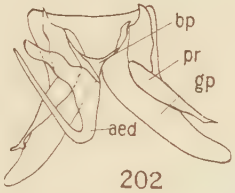

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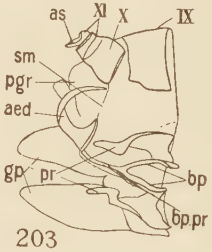

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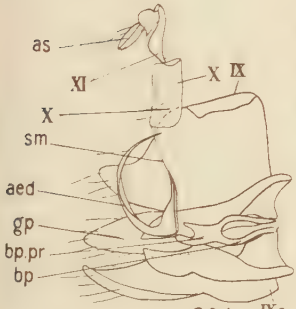

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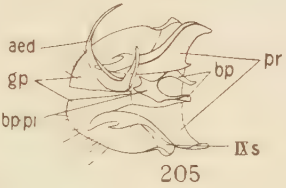

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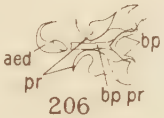

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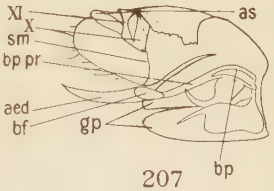

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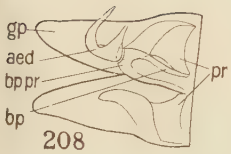

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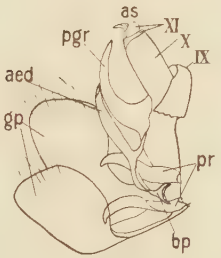

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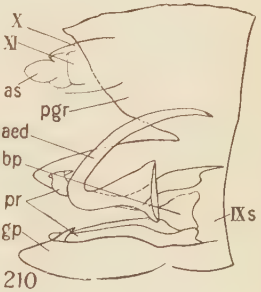

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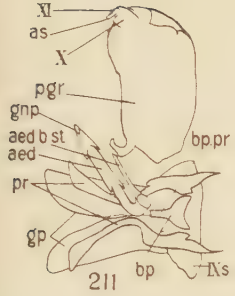

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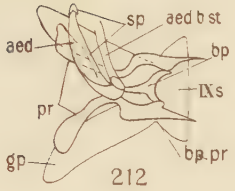

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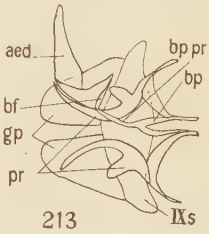

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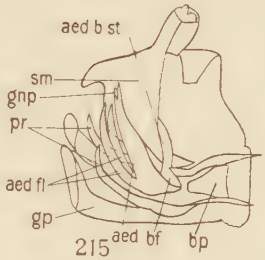

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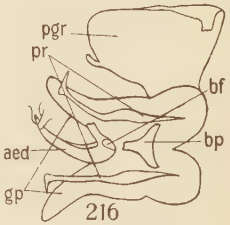

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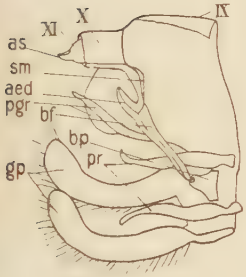

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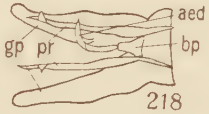

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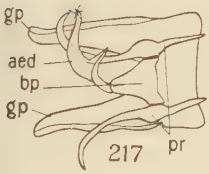

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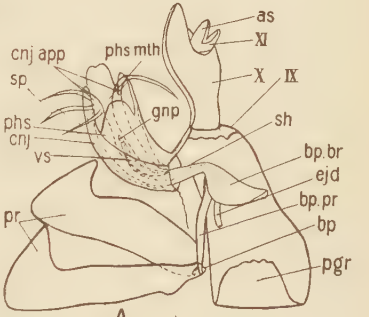

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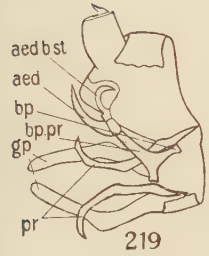

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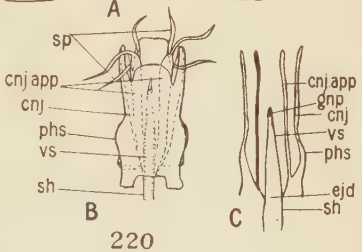

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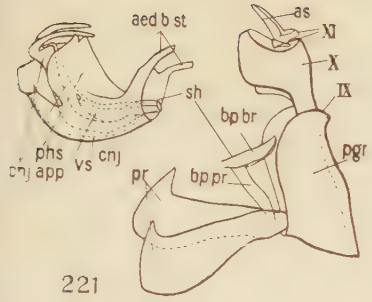

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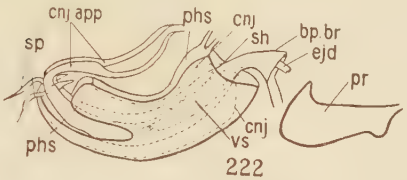

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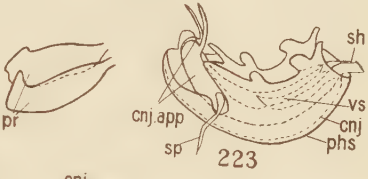

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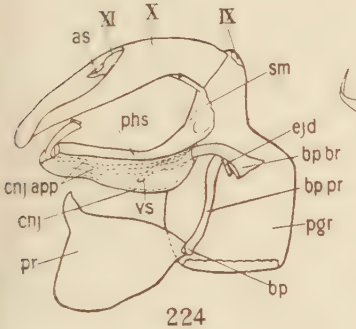

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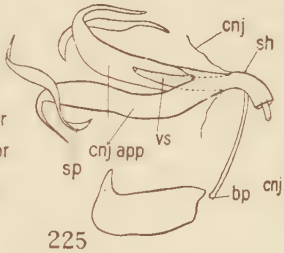

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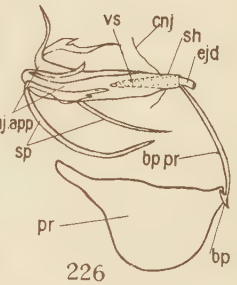

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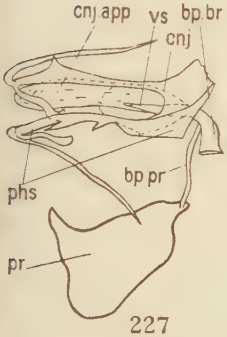

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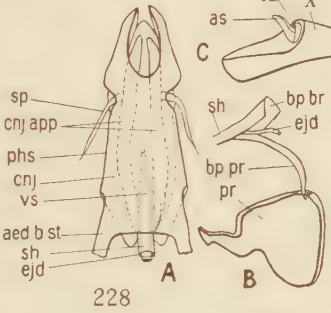

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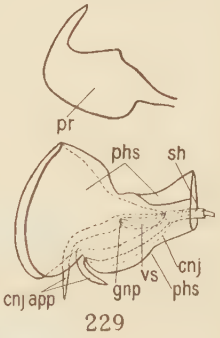

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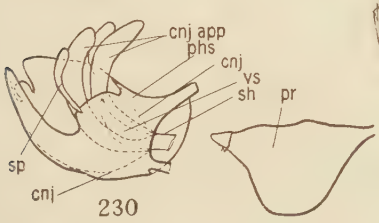

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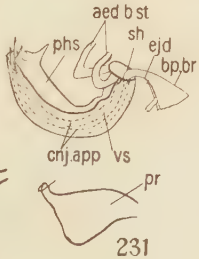

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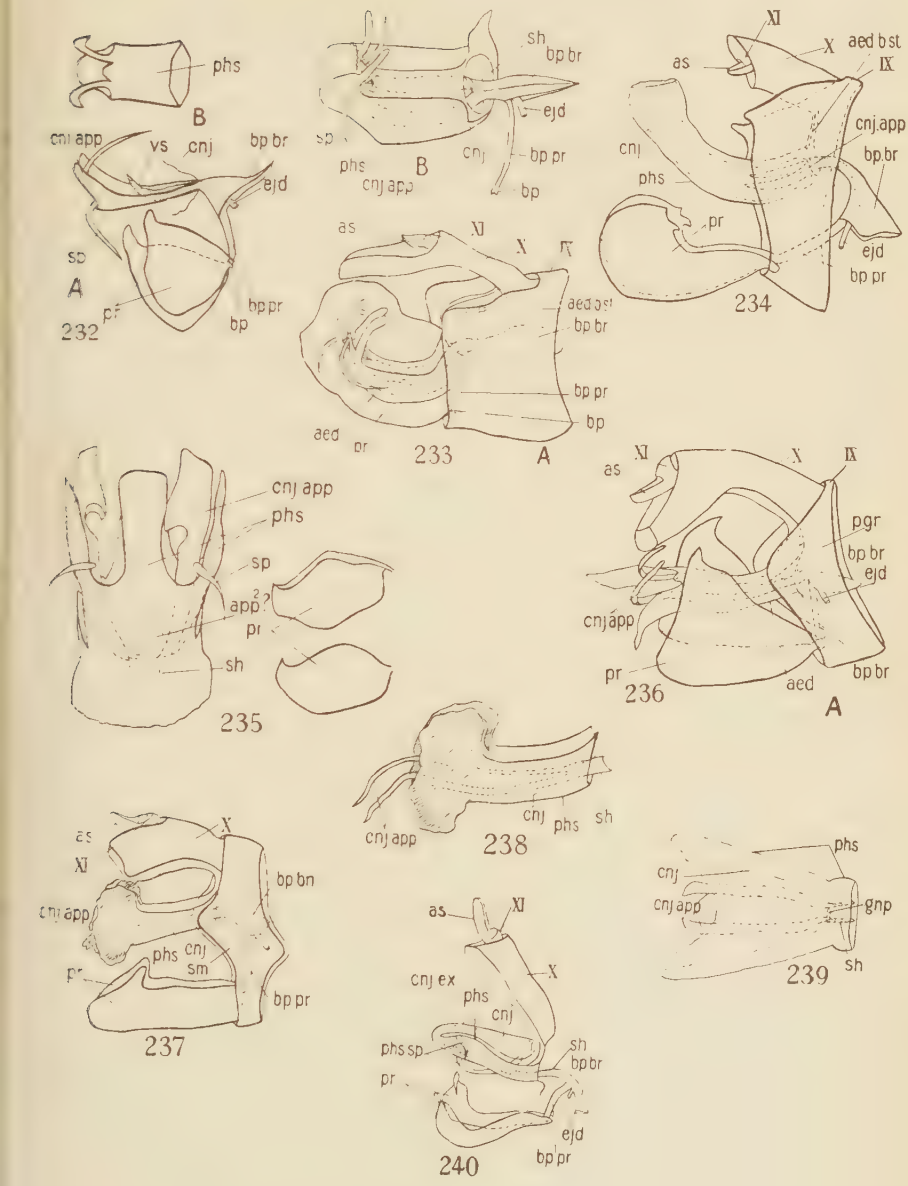

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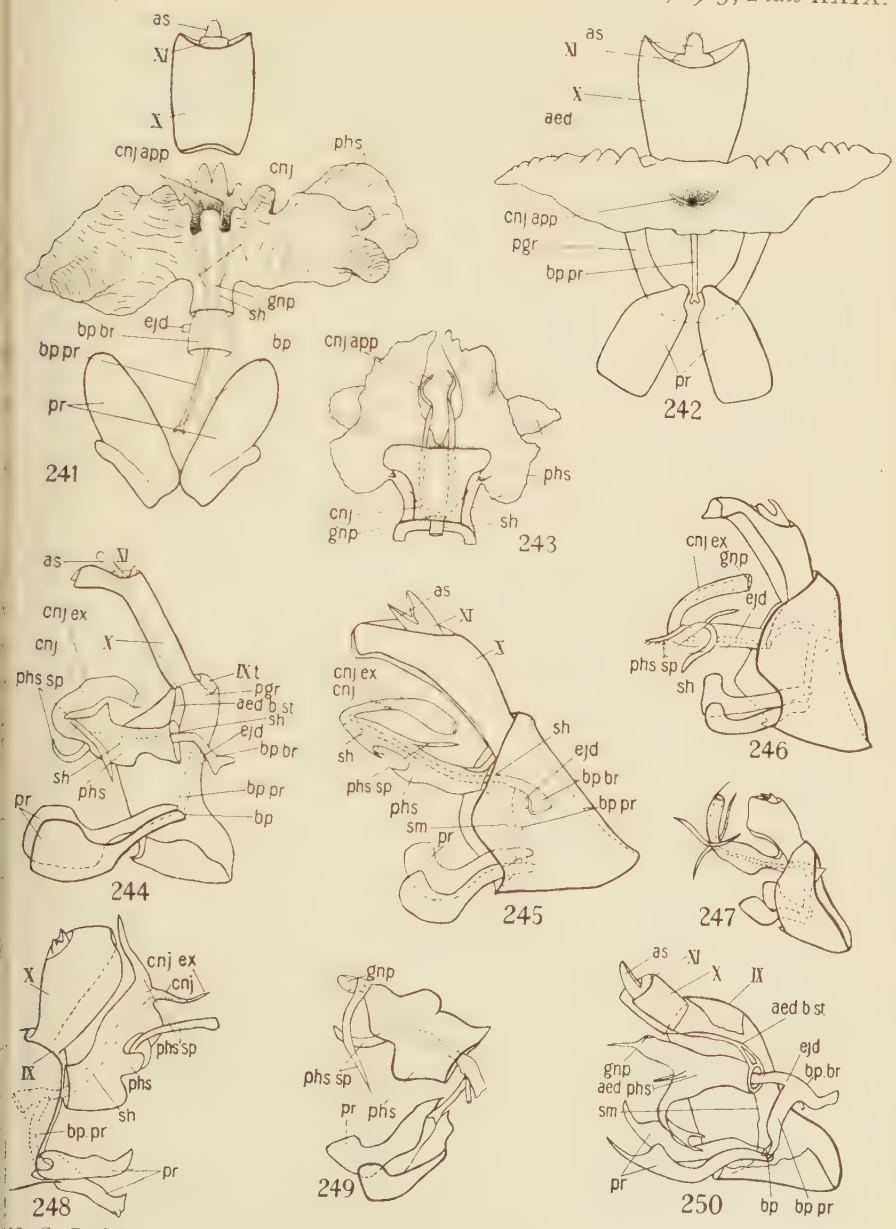

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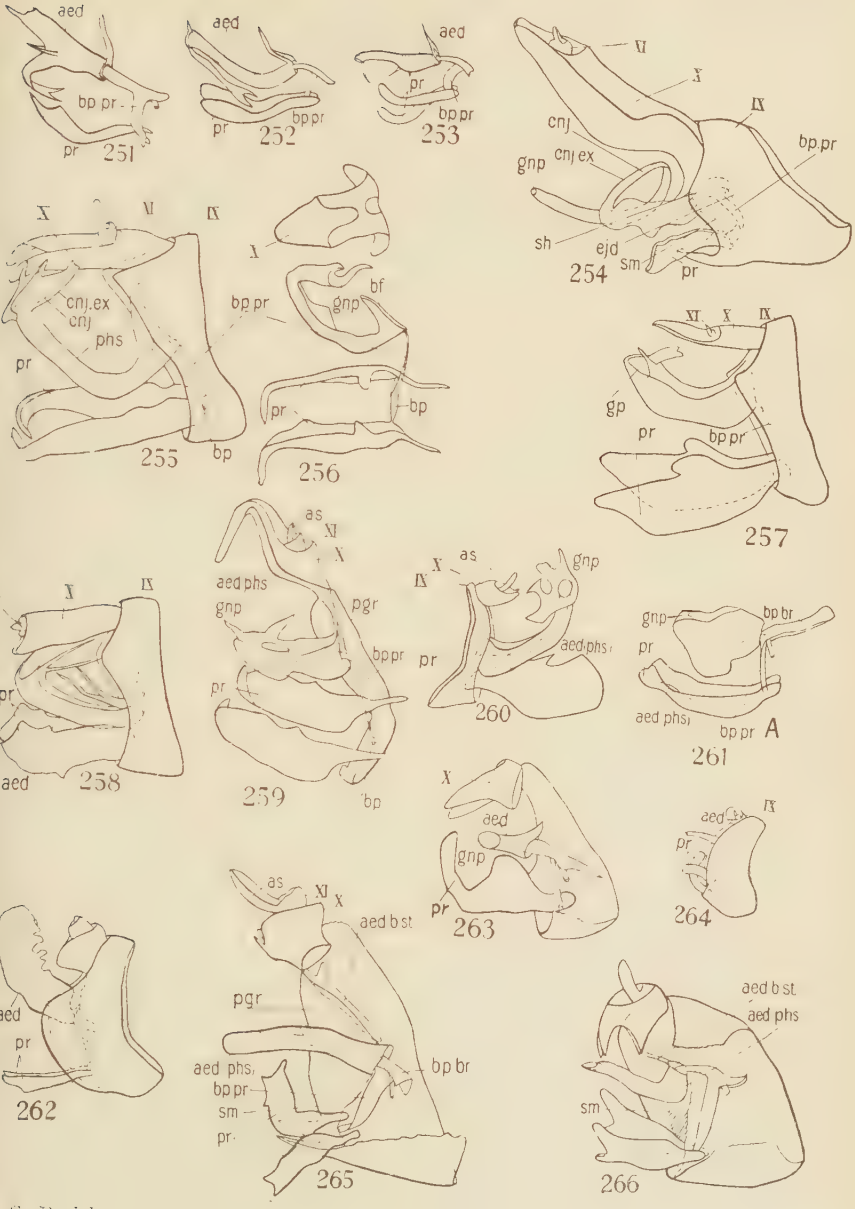

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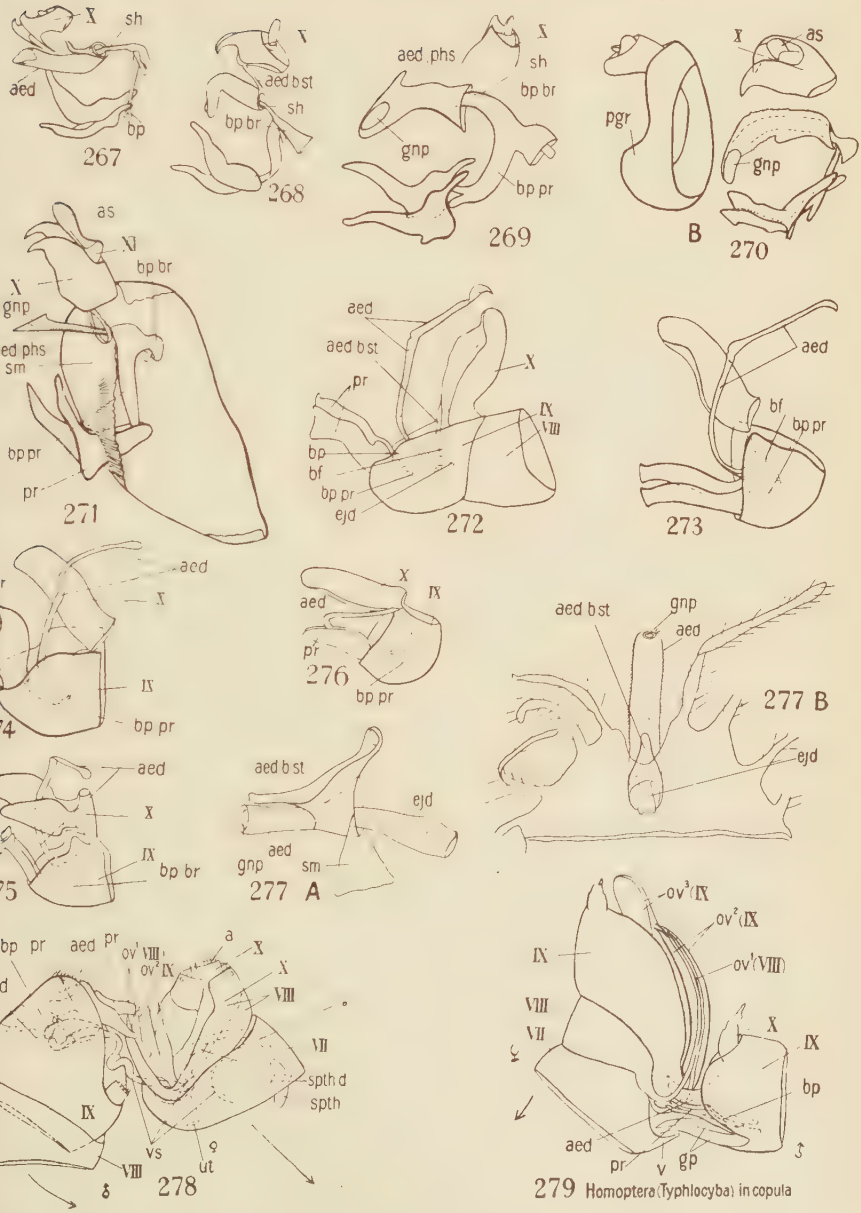

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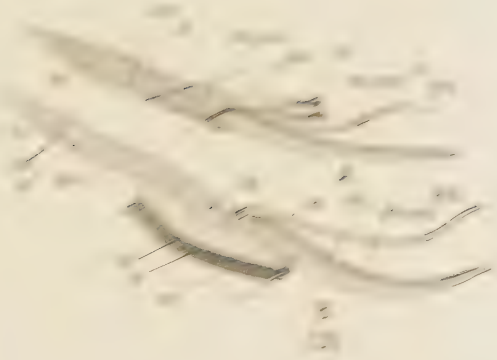

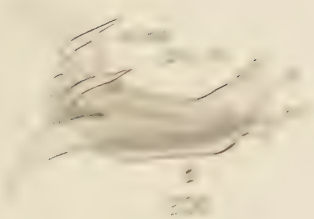

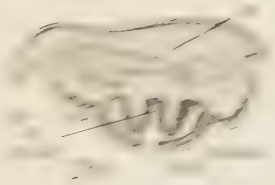

Fig. 51. *Arocatus sericans.* Dorso-lateral view. × 65.
52. *Chauliops lobatula.* „ „ „
53. *Ischnorhynchus ericae.* Lateral view. × 120.
54. *Blissus* sp. „ „
55. *Henestaris laticeps.* Surface view. × 65.
56. *Geocoris thoracicus.* Dorso-lateral view. × 65.
57. *Heterogaster urticae.* Lateral view. × 65.

PLATE XII.

(Lygaeidae *concld.* Pyrrhocoridae, Tingitidae.)

58. *Pachygrontha longiceps.* Lateral view. × 65.
59. *Oxycarenus laetus.* Surface view. × 120.
60. *Aphanus sordidus.* „ × 65.
61. *Trapezonotus arenarius.* Lateral view. × 80.
62. *Drymus brunneus.* „ × 65.
63. *Largus rufipennis.* Dorso-lateral view. × 35.
64. *Antilochus coqueberti.* Surface view. × 35.
65. *Odontopus varicornis.* „ × 35; pr × 15.
66. *Dysdercus cingulatus.* „ × 45.
67. *Urentius echinus.* A. Dorso-lateral view. × 120. B. IXth and Xth segments with parameres *in situ*.
68. *Dictyonota fuliginosa.* Lateral view. × 65.
69. *Piesma quadrata.* A. Surface view. × 120. B. Surface view IX, with parameres *in situ*.

PLATE XIII.

(Phymatidae, Reduviidae.)

70. *Phymata erosa.* Lateral view. × 65.
71. *Saica tibialis.* „ × 35.
72. *Tribelocephala comparanda.* Lateral view. × 35.
73. *Stenopoda culiciformis.* „ „
74. *Petalochirus umbrosus.* „ × 20.
75. *Velitra rubropicta.* „ × 35.
76. *Pirates hybridus.* „ × 65.
77. *Physorhynchus crux.* „ × 20.
78. *Ectrichoda crudelis.* „ × 35.
79. *Hammatocerus conspicillaris.* „ × 50.
80. *Apiomerus pilipes.* „ × 35.
81. *Cosmolestes picticeps.* A. Lateral view. B. Lateral view, IX and aedeagus *in situ*.

PLATE XIV.

(Reduviidae *concld.* Mesoveliidae, Hebridae, Nabidae Cimicidae, Capsidae.)

Fig. 82. *Velinus nigrigenu.* Lateral view. × 35.
83. *Endochus inornatus.* „ × 45.
84. *Occamus typicus.* „ „
85. *Mesovelia vittigera.* Lateral view. × 120.
86. *Hebrus ruficeps.* „ „
87. *Nabis major.* A. Lateral view. × 50. B. Surface view IX cut open. × 50.
88. *Nabis flavomarginatus.* Lateral view. × 65; pr × 45.
89. *Cimex lectularius.* Surface view. × 65.
90. *Anthocoris nemoralis.* „ × 80.
91. *Calocoris norvegicus.* Lateral view. × 50.
92. *Phytocoris ulmi.* Vesica and parameres. × 65.
93. *Stenotus binotatus.* „ „ „

PLATE XV.

(Capsidae *cont.*)

94. *Dichrooscytus rufipennis.* Lateral view. × 50.
95. *Lygus spinolae.* „ × 65.
96. *Camptobrochis lutescens.* Vesica. × 65.
97. *Capsus ater.* Lateral view. × 50; pr × 35.
98. *Acetropis gimmerthali.* Lateral view. × 120
99. *Stenodema laevigatum.* „ × 80.
100. *Notostira erratica.* Vesica and parameres. × 65.
101. *Teratocoris antennatus.* Lateral view. × 120.
102. *Miris (Leptopterna) dolobratus.* Lateral view. × 65.
103. *Monalocoris filicis.* „ × 120.
104. *Dicyphus constrictus.* „ × 65.
105. *Cyllocoris flavoquadrimaculatus.* „ „ pr × 35.

PLATE XVI.

(Capsidae *concld.* Ceratocombidae Hydrometridae Gerridae, Veliidae.)

106. *Mecomma ambulans.* Lateral view. × 120; pr 80.
107. *Orthotylus ochrotrichus.* „ × 65.
108. *Heterotoma meriopterum.* „ „
109. *Orthocephalus saltator.* „ „

Fig. 110. *Strongylocoris leucocephalus.* Lateral view. × 65.
111. *Psallus betuleti.* „ „
112. *Ceratocombus coleoptratus.* Lateral view. × 200.
113. *Hydrometra stagnorum.* Lateral view. × 65.
114. *Gerris* sp. A. Lateral view. × 50. B. IX–X. × 35.
115. *Gerris cereventris.* Lateral view. × 50.
116. *Velia currens.* „ „

PLATE XVII.

(Acanthiidae Velocipedidae Aepophilidae Notonectidae Naucoridae.)

117. *Salda* (*Chiloxanthus*) *pilosus.* A. Lateral view. × 65. B. IX, with parameres. × 35.
118. *Salda* (*Chiloxanthus*) *littoralis.* Dorso-lateral view. × 65.
119. *Velocipeda aliena.* Dorso-lateral view. × 65.
120. *Aëpophilus bonnairei.* „ „ „
121. *Notonecta* sp. A. Surface view, aedeagus. × 50. B. IX cut open, parameres *in situ.* × 25.
122. *Anisops niveus.* Lateral view, with IX–X. × 50.
123. *Plea minutissima.* A. Lateral view, aedeagus. × 120. B. Surface view, IX with parameres. × 80.
124. *Heleocoris minusculus.* A. Surface view, aedeagus. × 50. B. Surface view, IX–X with genitalia *in situ.* × 35. C. Lateral view, IX–X with aedeagus pulled out. × 35.

PLATE XVIII.

(Naucoridae *concld.* Belostomidae, Mononychidae, Corixidae.)

125. *Naucoris cimicoides.* Dorso-lateral view, aedeagus pulled backwards rapturing the posterior part of IX. × 45.
126. (Nepidae) on Plate XXXII.
127. *Belostoma* sp. Surface view, dorsal part of IX removed. × 35.
128. *Belostoma anura.* Lateral view. × 20.
129. *Mononyx grandicollis.* A. Lateral view. × 45. B. Surface view, IX. × 20.
130. *Pelogonus marginatus.* Lateral view. × 50.
131. *Corixa* sp. Lateral view (right). × 50.
132. *Micronecta* sp. Surface view. × 65.

PLATE XIX.

(CICADIDAE.)

FIG. 133. *Platypleura stridula.* A. Lateral view, rt. pygofer removed. × 20. B. Caudal view. × 20.

134. *Platypleura octoguttata.* Surface view, Xth segment. × 15.

135. *Cicada pulverulenta.* Lateral view, rt. pygofer removed. × 25.

136. *Rihana pontianaka.* A. Lateral view. × 20. B. Left pygofer. × 20.

137. *Cryptotympana* sp. A. Lateral view. × 20. B. Lateral view, X–XI. × 20.

138. *Dundubia mellea.* A. Lateral view. B. Lateral view, X–XI. × 20.

139. *Dundubia vaginata.* A. Dorso-lateral view. B. Surface view, X–XI. × 20.

140. *Diceropyga obtecta.* A. Lateral view. B. Lateral view, X–XI. × 20.

141. *Cosmopsaltria guttigera.* A. Dorso-lateral view. × 20. B. Left pygofer. × 20. C. Ventral view, X. × 20.

142. *Cosmopsaltria montivaga.* Ventral view, X. × 20.

143. *Platylomia spinosa.* A. Lateral view. × 20. B. Ventral view, X. × 20.

PLATE XX.

(CICADIDAE *concld.*)

144. *Pomponia* sp. A. Lateral view. × 20. B. Ventral view, X. × 20.

145. *Meimuna tripurasura.* Ventral view, X. × 15.

146. *Khimbya evanescens.* Lateral view. × 20.

147. *Goena maculata.* ,, ,,

148. *Balinta octonotata.* ,, ,,

149. *Fidicina opalina.* ,, × 15.

150. *Mogannia effecta.* A. Ventro-lateral view. × 25. B. Left pygofer. × 20.

151. *Huechys sanguinea.* Lateral view, rt. pygofer removed. × 20.

152. *Carineta formosa.* Lateral view. × 20.

153. *Tibicina haematodes.* A. Lateral view. × 20. B. Lateral view, X–XI. × 7.

154. *Abricta curvicosta.* Lateral view. × 20.

155. *Melampsalta germaini.* Lateral view, rt. pygofer removed. × 20.

PLATE XXI.

(MEMBRACIDAE, CERCOPIDAE.)

FIG. 156. *Oxyrhachis* sp. Lateral view, rt. pygofer removed. × 65.
157. *Leptocentrus* sp. Lateral view, rt. pygofer removed. × 65.
158. *Gargara* sp. Dorso-lateral view; sub-genital plates shown apart. × 50.
159. *Umbonia orozimbo*. Lateral view. × 35.
160. *Aethalion reticulatum*. „ „
161. *Darthula hardwicki*. „ , subgenital plates shown apart. × 35.
162. *Eoscarta borealis*. A. Lateral view, genitalia and IX–XI. × 50. B. Lateral view, aedeagus and parameres. × 50. C. rt. sub-genital plate. × 50.
163. *Tomaspis* sp. Lateral view, rt. pygofer removed. × 50.
164. *Tomaspis rubra*. Dorso-lateral view, rt. pygofer removed. × 25.
165. *Locris neavi*. Dorso-lateral view. × 35.

PLATE XXII.

(CERCOPIDAE *concld.*)

166. *Phymatostetha stellata*. Lateral view, rt. pygofer and sub-genital plate removed. × 20.
167. *Cosmoscarta* (*Suracata*) *basinotata*. Dorso-lateral view. × 20.
168. *Triecphora vulnerata*. Lateral view, rt. pygofer removed. × 35.
169. *Philaenus spumarius*. A. Lateral view, genitalia and posterior abdominal segments, rt. pygofer removed. × 45. B. Surface view, genitalia. × 45.
170. *Ptyelus mahei*. Surface view. × 35.
171. *Clovia puncta*. Lateral view, rt. pygofer and sub-genital plate removed. × 50.
172. *Aphrophora alni*. A. Dorso-lateral view, aedeagus and parameres. × 50. B. IXth–XIth segments with sub-genital plates, rt. pygofer cut off. × 50.
173. *Aphrophora maculata*. Surface view, sub-genital plates shown apart. × 65.
174. *Jembrana ornata*. Lateral view, rt. pygofer removed. × 50.
175. *Sepullia* sp. Lateral view, rt. pygofer removed. × 50.
176. *Machaerota ensifera*. Lateral view, genitalia and Xth–XIth segments. × 50.

PLATE XXIII.

(JASSIDAE.)

FIG. 177. *Tituria planata.* Lateral view, rt. pygofer cut off. × 35.
178. *Petalocephala* sp. Dorso-lateral view. × 35.
179. *Stenocotis dimorpha.* Lateral view, rt. pygofer cut off. × 35.
180. *Megophthalmus scanicus.* Lateral view, rt. pygofer cut off. × 80.
181. *Moonia variabilis.* A. Lateral view, rt. pygofer cut off. × 65. B. Surface view, genitalia. × 120.
182. *Idiocerus atkinsoni.* A. Lateral view, genitalia and IX–XI. × 65. B. Lateral view. × 65.
183. *Idiocerus cylpealis.* Surface view. × 65.
184. *Idiocerus scotti.* Dorso-lateral view, sub-genital plates shown apart. × 65.
185. *Idiocerus populi.* Dorso-lateral view, aedeagus and parameres. × 65.

PLATE XXIV.

(JASSIDAE *cont.*)

186. *Idiocerus confusus.* Dorso-lateral view, aedeagus and parameres. × 65.
187. *Idiocerus cognatus.* Lateral view, rt. pygofer cut off. × 65.
188. *Idiocerus vitreus.* Surface view, aedeagus and parameres. × 65.
189. *Idiocerus scurra.* Surface view, aedeagus and parameres dissected apart. × 65.
190. *Oncopsis flavicollis.* A. Lateral view, genitalia and IX–XI, rt. pygofer cut off. × 65. B. Surface view, genitalia and X–XI. × 65.
191. *Nehela aterrima.* Lateral view, rt. pygofer cut off. × 65.
192. *Ipo conferta.* Lateral view, rt. pygofer cut off. × 35.
193. *Eurinoscopus pelias.* Lateral view, rt. pygofer cut off. × 65.
194. *Eurymela distincta.* Surface view, genitalia dissected. × 20.
195. *Tettigoniella* sp. Dorso-lateral view, rt. pygofer cut off. × 65.
196. *Tettigoniella spectra.* Dorso-lateral view, genitalia. × 50.
197. „ *viridus.* „ „ „ × 45.

PLATE XXV.

(JASSIDAE *cont.*)

FIG. 198. *Bhandara sarawakensis.* Dorso-lateral view, genitalia. × 25.

199. *Euacanthus interruptus.* Lateral view, rt. pygofer cut off. × 35.

200. *Cyrtodisca major.* Lateral view, rt. pygofer cut off. × 35.

201. *Vulturnus vaedulcis.* Lateral view, rt. pygofer cut off. × 45.

202. *Gypona* sp. Surface view. × 35.

203. *Jassus modestus.* Lateral view, rt. pygofer cut off. × 45.

204. *Athysanus obsoletus.* Lateral view, rt. pygofer cut off. × 65.

205. *Athysanus sordidus.* Dorso-lateral view. × 50.

206. *Balclutha chersonesia.* Dorso-lateral view. × 65.

207. *Scaphoideus vagans.* Lateral view, rt. pygofer cut off. × 120.

208. *Deltocephalus ocellaris.* Dorso-lateral view, genitalia. × 65

209. *Tharra nausika.* Lateral view, rt. pygofer cut off. × 45.

210. *Dorycephalus subreticulatus.* Lateral view, rt. pygofer cut off. × 65.

PLATE XXVI.

(JASSIDAE *concld.* FULGOROIDEAE.)

211. *Doratura stylata.* Dorso-lateral view, genitalia. × 45.

212. *Acocephalus albifrons.* Lateral view, rt. pygofer cut off left pygofer dissected apart. × 45.

213. *Acocephalus flavostriatus.* Dorso-lateral view, genitalia. × 45.

214. *Chlorita viridula.* Lateral view, rt. pygofer cut off. × 65.

215. *Eupteryx germari.* Lateral view, rt. pygofer cut off. × 65.

216. *Eupteryx auratus.* Dorso-lateral view, rt. pygofer cut off. × 65.

217. *Typhlocyba rosae.* Dorso-lateral view, genitalia. × 65.

218. „ *debilis.* „ „ „ „

219. „ *ulmi.* Lateral view, rt. pygofer cut off. × 65.

FIG. 220. *Ricania* sp. A. Lateral view, genitalia and IX–XI, rt. pygofer cut off, parameres pushed out of the IX, spine of the left conj. app. not figured. × 45. B. Surface view, aedeagus. × 45. C. Plan of different parts of aedeagus—diagrammatic. × 45.

PLATE XXVII.

(FULGOROIDEAE *cont.*)

221. *Euricania splendida.* Lateral view, genitalia and IX–XI, aedeagus figured apart. × 35.
222. *Pochazia sinuata.* Lateral view, aedeagus and a paramere. × 65.
223. *Osaka hyalina.* Lateral view, aedeagus and parameres. × 65.
224. *Melicharia tripars.* Lateral view, rt. pygofer and paramere cut off. × 35.
225. *Hansenia glauca.* Lateral view, conjunctiva appendages, vesica, paramere. × 20.
226. *Phyllyphanta* sp. Lateral view, conjunctiva appendages, vesica, paramere. × 20
227. *Colgar peracuta.* Lateral view, genitalia, rt. paramere and rt. conjunctiva appendage not figured. × 35.
228. *Tetrica bifasciata.* A. Surface view, aedeagus. × 50. B. Lateral view, parameres and basal plates, etc. × 35. C. Lateral view, X–XI. × 35.
229. *Caliscelis eximia.* Lateral view, aedeagus (× 120) and a paramere (× 65).
230. *Dindinga oculata.* Lateral view, aedeagus (× 45) and a paramere (× 35).
231. *Hemisphaerius* sp. Lateral view, aedeagus (× 45) and a paramere (× 35).

PLATE XXVIII.

(FULGOROIDEAE *cont.*)

232. *Thabena patula.* A. Lateral view, parameres and aedeagus without phallosoma. × 65. B. Dorso-lateral view, phallosoma. × 35.
233. *Pyrilla* sp. (near *perpusilla*). A. Lateral view, genitalia and IX–XI, rt. paramere not figured. × 45. B. Dorso-lateral view, aedeagus. × 65.
234. *Ivinga typica.* Lateral view. × 45.

Fig. 235. *Eurybrachys dilatata.* Surface view, aedeagus (× 50) and parameres (× 35).

236. *Dictyoptera hyalinata.* A. Lateral view, genitalia and IX–XI. × 35. B. Lateral view, aedeagus. × 40. (See Plate XXXII.)

237. *Dictyophara* sp. Lateral view. × 45.

238. *Putala figurata.* Lateral view, aedeagus. × 45.

239. *Centromeria viridistigma.* Surface view, aedeagus. × 65.

240. *Aselgeoides insularis.* Lateral view, genitalia and X–XI. × 65. Text description after that of Fig. 246.

PLATE XXIX.

(Fulgoroideae *cont.*)

241. *Gebenna sylvia.* Surface view, genitalia and X–XI. × 25.

242. *Fulgora candelaria.* Caudal view, genitalia and IX–XI. × 20.

243. *Scamandra* sp. Ventral view, aedeagus. × 20.

244. *Cixius nervosus.* Lateral view, rt. pygofer cut off. × 50.

245. *Brixia stellata.* ,, × 65.

246. *Adolendana typica.* ,, ,,

247. *Caneirona indica.* ,, × 45.

248. *Mundopa sita.* ,, (left side). × 65.

249. *Oliarus nuwarae.* Lateral view, genitalia. × 65.

250. *Volcanalia picturata.* Lateral view, rt. pygofer removed. × 65.

PLATE XXX.

(Fulgoroideae *cont.*)

251. *Volcanalia fumosa.* Lateral view, aedeagus and a paramere. × 50.

252. *Volcanalia sulphurata.* Lateral view, aedeagus and parameres. × 50.

253. *Volcanalia atrovaria.* Lateral view, aedeagus and parameres. × 50.

254. *Ossa formosa.* Lateral view, genitalia and IX–XI. × 35.

255. *Zeugma monticola.* Lateral view, genitalia and IX–XI. × 35.

256. *Lamenia caliginea.* Lateral view, genitalia and dorsolateral view, X. × 35.

257. *Philadelpheia pandani.* Lateral view, genitalia and IX–XI. × 35.

Fig. 258. *Basilocephalus thaumatonotus.* Lateral view, genitalia and IX–XI. × 35.

259. *Phenice moesta.* Lateral view, rt. pygofer removed. × 50.

260. *Aquaelicium typicum.* Lateral view (left), rt. paramere not figured. × 65.

261. *Nisia atrovenosa.* A. Lateral view, genitalia. × 80. B. Lateral view, IX–XI. × 65.

262. *Tettigometra* sp. Lateral view, genitalia and IX–XI. × 50.

263. *Robigalia butleri.* Lateral view, genitalia and IX–XI, rt. pygofer cut off. × 50.

264. *Achilixius tubulifera.* Lateral view, genitalia and IX–XI. × 50.

265. *Perkinsiella saccharicida.* Lateral view, genitalia and IX–XI, rt. pygofer removed. × 65.

266. *Opiconsiva colorata.* Lateral view, genitalia and IX–XI, rt. pygofer removed. × 120.

PLATE XXXI.

(Fulgoroideae *concld.* Psyllidae. Coccidae. bugs *in copula.*)

Fig. 267. *Chloriona glaucescens.* Lateral view, genitalia and X–XI. × 65.

268. *Delphax pellucida.* Lateral view, genitalia and X–XI. × 65.

269. *Stiroma nigrolineata.* Lateral view, genitalia and X–XI. × 65.

270. *Stiroma pteridis.* Lateral view, genitalia and X–XI. × 65.

271. *Dicranotropis hamata.* Lateral view, genitalia and IX–XI, rt. pygofer cut off. × 65.

272. *Arytaena genistae.* Lateral view, genitalia and VIII–XI. × 120.

273. *Psylla hyppophaes.* Lateral view, genitalia and IX–XI. × 80.

274. *Livia juncorum.* Lateral view, genitalia and IX–XI. × 120.

275. *Aphalara nebulosa.* Lateral view, genitalia and IX–XI. × 120.

276. *Rhincola ericae.* Lateral view, genitalia and IX–XI. × 120.

FIG. 277. *Monophlebus stebbingi*. A. Lateral view, genitalia. × 50. B. Surface view, genitalia and posterior abdominal segments. × 35.

278. Heteroptera (*Lygaeid*) *in copula*. The arrows point towards the head end of the individuals. × 65. ov^1 = anterior ovipositor; ov^2 = posterior ovipositor; *ovd* = oviduct; *spth* = spermatheca; *spth.d* = spermathececal duct; *ut* = uterus; *vs* = vesica; *re* = retractor muscles attached to the basal plates.

279. Homoptera (*Typhlocyba*) *in copula*. × 120. *v* = valve; ov^1–ov^3 = anterior, posterior and dorsal ovipositor.

PLATE XXXII.

126. *Isocerophes maculatus* (Nepidae). A. Lateral view, aedeagus. × 50. B. Lateral view, with the diverticulum of the phallosoma out of the basal plates.

236. *B. Dictyoptera hyalinata* (Dictyopharidae). Lateral view, aedeagus. × 40.

280. Transverse section through the IXth segment of *Idiocerus* (Hompt.) nymph. × 120. pl (= *aed* + *pr*) = parameres lobes (= rudiments of aedeagus and parameres); *int* = intestine.

VI. *On the Abdominal Glands in* Heliconius (Lepidoptera).

By H. Eltringham, M.A., D.Sc., F.Z.S.

[Read March 18th, 1925.]

Plate XXXIII.

That remarkably observant naturalist the late Fritz Müller, whose name will ever be perpetuated in connection with his hypothesis on the intermimetic relations of distasteful insects, laid the foundations of research on scent-producing organs by his discoveries of structures then looked upon as comparatively rare, though now known to be of widespread occurrence. The feeble and almost atrophied olfactory powers of the human race have made it somewhat difficult for naturalists to realise what an important rôle that sense may play in the economy of creatures gifted with an olfactory sensitiveness, the possibilities of which we can scarcely imagine. That an insect may have the power of producing a scent which is repulsive to its enemies is more easily understood, since we are acquainted not only with insects which have this power, but also with vertebrate animals, such as snakes, skunks, etc., which are proverbial examples of such methods of defence. In insects, however, this familiar use of volatile secretions is less widely known than the more subtle odours which we know to be utilised for purposes designed to further the continuance of the species. The elaborate brushes and glands of the Danaine butterflies, the scent-scales of many families, the "chain bristles" of the Hesperiidae, were all observed by Müller nearly fifty years ago, though his examination was mainly superficial, and no doubt the means at his disposal were inadequate for detailed histological research.

The scents produced by insects seem to fall into three categories: those which are produced by a female to enable the male to find her, those produced by the male as charming or exciting perfumes, and thirdly those odorous secretions which are to be regarded as repulsive, and so protective in their nature. To the third class belong the objectionable secretions of Orthoptera and Hemiptera, the acrid juices exuded by certain larvae and moths, and also by Danaine, Acraeine and other butterflies, and the volatile exudations of what Müller called the "Maracujá butter-

flies." The Maracujá is a Passion Flower, and the species of *Heliconius*, *Eueides*, *Colaenis*, and *Dione* all feed, in the larval state, on these plants. Müller's observations on these and other groups appeared in various publications in the 'seventies, and fortunately for English readers the papers containing them have been translated, and on Professor Poulton's excellent suggestion, republished as an appendix to the late Dr. Longstaff's " Butterfly Hunting in Many Lands " (London, 1912).

I propose here to summarise Müller's observations, since, having been made by an acute observer on the living or freshly killed insects, they have a value for non-histological purposes far exceeding that of any we can make in this country on the preserved material. According to Müller the butterflies of the above genera are closely allied in both structure and habits. " The males, when seized, open wide the anal valvulae, from the inner side of which there appear two glands yielding a strong and nauseous smell. The females, on the contrary, emit a similar smell from a yellow gland extruded on the dorsum between the last and penultimate segments." The large gland of the female is quickly extruded on a first alarm, but more slowly on a second interference, and on these latter occasions the smell did not increase gradually but was suddenly and noticeably strengthened. This sudden increase was correlated with the appearance of two laterally placed club-like organs, somewhat resembling in shape the halteres of Diptera. " One has only to cut off the apex of one of these stink-clubs in order to become convinced that the strengthened smell of the stink-gland really proceeds from them." He found these club-like organs in *Colaenis*, *Heliconius*, *Dione*, and *Eueides*. The shape of the club varies somewhat from pyriform to almost spherical. The apex bears special scales more or less specific in character, and having apical teeth of rather stouter texture than the more basal part of the scale, which is often thin and flexible. Figures of a number of these types are given. They are, in the living insect, matted and clogged with the secretion. Alcohol and other solvents remove the greater part of this, leaving only a residue of small refractive, more or less spherical particles.

Müller's observations here recalled would seem never to have been confirmed or extended. There is generally much difficulty in inducing collectors to forward material

in a properly preserved condition suitable for histological research. Such investigations as I have been enabled to make into the structure of various organs in exotic Lepidoptera have only been possible through the kindly coöperation of such good friends as Neave, Lamborn, Carpenter, and others, none of whom have so far had opportunities of visiting S. America. More recently, however, my friend Dr. H. L. Withycombe, of the Department of Agriculture in Trinidad, has very kindly sent me much excellent material both of *Heliconius* and other genera exhibiting interesting features, and I am glad of the opportunity here afforded of expressing to him my gratitude for the great trouble he has taken and for the excellent state of preservation of his material.

In a letter to Professor Poulton dated Nov. 22, 1923, this naturalist says :

" On being removed from the net and held between the fingers both species (Nos. 1–4 and 5)* bent the tip of the abdomen ventrally at frequent intervals, much in the same way as a dragon-fly will do when held in the fingers, but somewhat more rapidly. The males (Nos. 2 and 4)* widen apart the lateral valves at the apex of the abdomen at the same time as the abdomen is bent under, but only a faint odour is given off. The females also bend the abdomen under in a similar way, but at the same time they evert a pair of orange-coloured glands (see sketch). These glands are the source of the odour like phenyl carbylamine (C_6H_5NC). From the fact that they are only everted when the insect is seized and that they are only distinctly developed in the female,† I am inclined to regard them as repugnatorial glands, and to consider that the odour is distasteful to enemies. The odour is best described as being like carbylamine when first given off, but the smell left upon the fingers, after some time, is less offensive and not unpleasant; in fact, it recalls somewhat the odour of sweet briar. In dissecting the abdomen of some males under water, near the base of the lateral valves I found a yellowish-white amorphous mass on each side. This when liberated floated to the surface of the water in the dissecting glass and immediately dispersed at the surface. I collected some of it and found it to smell strongly of the carbylamine-like odour, so that the males also *should* be capable of giving

* Spirit specimens not yet identified.

† As will be seen later, Dr. Withycombe was misled on this point.

off a fairly strong odour. I want to examine more specimens on this point as I cannot find any definite glands."

Having discussed the possibility of making some actual tests for carbylamine, since further observation caused him to doubt the actual presence of this substance, Dr. Withycombe then says: "My latest opinion is that it will turn out to be more complex than phenylcarbylamine, possibly the compound contains an isonitrile (N ≡ C) grouping."

In a subsequent letter Dr. Withycombe informs me that he has returned to his first opinion, and that the odour is that of carbylamine, though actual chemical tests are still lacking.

On Plate XXXIII, fig. 1, I have drawn a lateral view of the extremity of the female abdomen of *Heliconius hydarus*. The large extrusible gland *g* is more or less bifid, and its external surface consists of a delicate membrane, which is thrown into a complex series of folds and projections which in section have the appearance shown at *ext*, fig. 3. It seems probable that there may be a certain amount of diffusion of the volatile substance from this membrane, though the regular excretion and distribution is carried out through the clavate structure *cl*. The shape of this varies somewhat in different species as noted by Müller, and according to my own observations it also varies somewhat in different individuals. I was at first inclined to suppose that the club had a separate gland of its own, but careful examination of a series of sections shows that the lumen of its stalk does in fact open into the interior part of the spongy mass of the gland *g*. In these sections I naturally expected to find a well-developed system of active glandular cells, and was somewhat surprised to discover that the greater part of it is occupied by a structureless granular mass interspersed here and there with obvious fat cells, and darkly stained bodies which have the appearance of cell nuclei bereft of their surrounding cytoplasm. The solution of the mystery appears to lie in the structure of a few of the most anterior sections. One of these is shown in fig. 3. Deeply stained nuclei (haematoxylin) occur in masses, surrounded by granular protoplasm as shown at *gc*. Cell walls are poorly defined and the general appearance is that of partial disintegration. In the more or less clear spaces of the spongy mass are found nuclei surrounded by structureless granular substance as at *n*, and the interpretation seems to be that the early activity of the gland-

cells, either on emergence, or even in late pupal life, is so violent that breakdown of the cells occurs, so that there is within the gland a state of partial or complete histolysis. Such a phenomenon would seem to occur in other lepidopterous glands, as for instance in the male accessory glands of *Parnassius apollo*, described by me in another paper in the present issue of the Transactions.

Fig. 5 shows a more highly magnified view of the gland-cells or what remains of them. As there depicted the cell walls are ill-defined or absent, and in one case little more than a nucleus remains.

Fig. 6 is a more highly magnified view of the club-shaped distributor from which for the sake of clearness I have removed all but a few of the terminal scales. Fig. 7 shows one of the scales still more enlarged. While this figure shows the general type of the scales, it should be remembered that they are very irregular in the number of their projections. The latter, as Müller observed, are of somewhat harder consistency than the rest of the scale, the whole of which is hollow. The scale-stalk is an extremely thin-walled tube and is fitted into a socket of the ordinary "thistle-head funnel" type. Inside the club and its stalk is a thin layer of hypodermal cells taking a deep stain with haematoxylin.

Fig. 2 is a ventral view of the expanded terminal segments of the male abdomen. In the centre at the upper part of the figure is the uncus, curved over towards the observer, and immediately beneath it is the anal orifice, the surrounding tissues of which are, in this example, somewhat inflated. The two claspers *hh* are but lightly chitinised, except at the upper dentate edge, and on their inner surface is a cushion-like pad having an elongate orifice *go*. This is the external opening of a large gland. Transverse sections of the clasper at right angles to the glandular orifice have the appearance shown at fig. 4, where *go* is again the external opening, evidently leading into a large flattened lumen. Indeed the whole glandular apparatus can be dissected out by carefully removing the outer walls of the clasper, and it is then found to have the shape of a tea-cosy, *mb* in fig. 4 representing the internal quilted part. The gland cells *gc* are here in a perfect and unbroken condition and form a single complete layer, usually thicker near the orifice *go* than in the more proximal parts. These cells are typical active gland-cells. Two of them are

shown under a much higher power in fig. 8. There is a large, darkly-staining, somewhat granular nucleus *n*, surrounded by a vacuolated, also rather darkly staining cytoplasm, and the outer edge of the cell, *e*, is modified to form a kind of membrane which takes a lighter stain except for a few more or less radially placed granulations, and also exhibits still paler lines which would appear to be pores or ducts. The rather thick membrane *mb*, fig. 4, shows no special structure except numerous fine lines more or less at right angles to the cell layer, and on a surface view it has a dotted appearance. It is evidently porous, and allows the passage of the volatile fluid from the gland cells to the central lumen. The remaining contents of the section consist of muscles *m*, a few tracheae, fat cells *f*, granules *gr*, and doubtless nerves, which, however, by this method of staining would probably not be discernible.

These offensive glands present a case which, so far as we know at present, is peculiar to the species of *Heliconius* and its near allies. Dr. Withycombe informs me that *Colaenis julia*, of which he has kindly sent me three males, also emits a scent, but that it is not, to his senses, the same as that produced by the *Heliconius*. I have made sections from one of these specimens and find that the gland in the interior of the clasper differs in several respects from that in *Heliconius*. The central lumen is plicate and so presents a more complicated appearance, the membrane corresponding to *mb*, fig. 4, is a spongy mass with large vacuoles, and the gland-cells are quite different in appearance. They are thicker and more regular and constitute what may be described as a columnar epithelium. The cytoplasm is but little vacuolated and there is no poriferous border. Moreover, treated with Mann's stain, they absorb and retain the methyl blue rather than the eosin, especially the nuclei, which thus remain a deep blue instead of a deep red as in *Heliconius*. I do not wish to lay too much stress on this character without having made further preparations, as the proportion of red and blue in a section stained with these reagents varies to some extent even in the same series of sections, but there is at least an indication of a different chemical composition as between *Heliconius* and *Colaenis*.

If the glands here described were present in the male only we should regard them as of purely sexual significance. Even the fact that they are in different positions in the two sexes, and of different structures would also support this

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ABDOMINAL SCENT GLANDS IN HELICONIUS.

view, were it not for the fact that from the descriptions of those who have observed the insects in life it is evident that both sexes use their glands in a similar way, and the scent material seems to be the same, although arising from sexually different glands. Also we know that in *Heliconius* the purely sexual scent apparatus is provided in the males in the form of scent-scales or androconia, which are well developed and were observed and described by Müller. We must, I think, conclude that these glands are repugnatorial in function. I know of no similar structures in other female Lepidoptera, though glands of an elaborate nature are found in the claspers of certain male moths, notably in *Rhodogastria*, as described by Mr. Bethune-Baker in the present issue of our Transactions.

Description of Plate XXXIII.

Fig. 1. Lateral view of terminal portion of the abdomen of *Heliconius hydarus*. *cl*, the club-shaped organ. *g*, the exterior of the gland.

2. Ventral view of the expanded terminal segments of the male. *hh*, the claspers. *go*, the external orifice of the harpal gland.

3. A section through the female gland near its proximal part. *gc*, the gland-cells. *n*, detached nuclei in the spaces of the tissue. *ext*, the outer irregular surface.

4. A section through the male clasper at right angles to the external orifice of the gland. *go*, the external orifice. *f*, fat cells. *m*, muscles. *gr*, granules (probably blood). *gc*, the gland cells. *mb*, the internal membrane.

5. Cells from *gc*, fig. 3, more highly magnified.

6. More magnified view of extremity of club of female, with a few of the scales remaining attached.

7. One of the scales more highly magnified.

8. Two of the gland cells from the male clasper. *nn*, the nuclei. *e*, the poriferous border.

Diameter of apparent pores in cell border, fig. 8, ·0007 mm.
Greatest width of scale, fig. 7, ·08 mm.
Mean thickness of glandular epithelium, fig. 4, ·03 mm.

VII. *On the Structure of the Ocelli in* Plusia gamma (Lepidoptera).

By H. Eltringham, M.A., D.Sc., F.Z.S.

[Read March 18th, 1925.]

Plate XXXIV.

In Trans. Ent. Soc., 1919, I gave an account of the structure and function of the compound eyes of butterflies together with some discussion on their colour-sensitiveness. In addition to the compound eyes, many insects, including some Lepidoptera, are provided with simple eyes or ocelli, and the moths of the genus *Plusia* furnish examples of these organs. In *Plusia gamma* the ocellus is easily seen under a low power, and has the appearance of a minute black protuberance surmounted by a clear jewel-like lens. It lies above the compound eye and just posterior to the base of the antenna as shown in fig. 1, Plate XXXIV, which is a lateral view of part of the head of the moth. There does not appear to be any difference in the development of the ocelli in the two sexes. Round the ocellus there are numerous stiff hairs. This and their structural arrangement point to the importance and functional activity of the organ. The soft elongated scales which cover the greater part of the head would tend to obscure the small lens, but their modification into stiff hairs round the ocellus forms a protective screen, and ensures the uninterrupted access of light to the organ.

If the head be removed and examined from behind under the stereoscopic microscope, the transparency of the chitin at the back of the head, between the eyes, enables one to see the slender nerve arising from the posterior lobes of the brain, and entering the ocellus, beneath which it becomes expanded into a bulb of sensitive nerve-endings.

Sections of the organ are not easy to prepare. If together with its nerve it be removed from the surrounding tissue, the ocellus is so minute an object that it is difficult to handle and to orientate on the microtome. If the surrounding tissue be included, the heavy chitinous ridge which always exists round the edge of the compound eye is very apt to cause breakage and disintegration of the closely adjacent ocellus. Both the above alternatives were, however, attempted, the latter by the celloidin double embedding

process by which the section shown in fig. 2 was ultimately obtained. The material was preserved in picro-chlor-acetic acid fixative, and some of the sections were treated with iron haematoxylin and others with Mann's stain.*

The principal features of the internal structure of the ocellus are shown in fig. 2. The chitin, *c*, of the cuticle forms, on the surface of the head, a projection, the lateral portions of which are deeply pigmented, as shown by the black areas in the drawing. The apical part is transparent and thickened to form the lens l. This lens is very hard, at least in preserved material, and I have not been able to cut sections without breaking it. Beneath the lens is a mass of granular tissue which shows traces of a cellular structure. It is not very well defined in my preparations, and I am at present rather doubtful as to its nature. It suggests a tissue somewhat analogous to the "*processus corneae*" of the compound eye. Beneath this we find the nerve bundles *nb*. Their distal portions are granular and they here take a somewhat darker stain than in other parts of their length. Proximally to this area there are numerous large elongated nuclei, *nc*, and a few pigment cells, the latter indicated principally by the minute spherical pigment granules. Beneath these there occurs a transverse membrane *m*. Such a structure would seem to be unusual in simple eyes, though it is very distinct in my preparations of this species. The nerves pass through it in a manner very suggestive of analogy with the fenestrated membrane in compound eyes. In the organ taken as a whole the nerves form an expanded pyriform bundle, and thus, in sections, some of those nerves which curve outwards to the sides appear cut off as at *x*. Beneath the membrane the nerve bundles converge into the main cord communicating with the brain. Pigment cells, *p*, occur throughout this portion of the organ.

Transverse sections are represented in figs. 3 and 4. Fig. 3 is a section of the narrower proximal part showing the delicate sheath and the nerves cut across and presenting a dotted appearance, probably indicating the individual fibres. Occasional pigment granules are seen, together with darker staining portions, probably connective tissue. Fig. 4, a section of the more expanded part, shows only four of the elements which make up the whole mass. In

* These processes will be found described in the paper on the compound eye already referred to.

this area the nerves are now collected into bundles of irregular size and contents, and the connective tissue, pigment cells, etc., seem to form a kind of matrix pierced by tubes, in each of which lie two or more nerves. I was at first inclined to suppose that this formation began at the membrane *m*, fig. 2, but the inference was disproved as several sections both above and below the membrane show the same appearance, and the membrane is much too thin to appear more than once in transverse section, whereas the segregation of the nerves into enclosed bundles takes place gradually, increasing as one passes from section to section.

The ocelli of insects present many variations of structure, starting from very primitive forms consisting of a mere thickening of transparent chitin with a few nerve-endings beneath it, to elaborate structures such as that found in a species of *Chloëon* (figured by Hesse, Zeit. Wiss. Zool., 1901, pl. xvi, fig. 15). In this eye the lens is multicellular and the nerve apparatus beneath it approaches in complication that of a compound eye. Some ocelli go even further than this, for in that of a species of *Agrion* (*l.c.* pl. xvii, fig. 26) there are beneath the lens well-developed ommatidia ending distally in "crystalline cones." The structure most nearly corresponding with that in *Plusia gamma* is found in a Coreid bug, *Syromastes marginatus* (*l.c.* pl. xvi, fig. 13), whilst the ocellus of a flea, *Ceratopsyllus canis* (*l.c.* pl. xvii, fig. 17), is also very similar.

We may, I think, regard the ocelli of *Plusia gamma* as in a medium state of development and, from their position and nerve distribution, certainly functionally active. The necessity for their existence is less easy to explain. *P. gamma* is active both by day and night, but if there be any connection between this habit and the ocelli it does not explain the presence of the same organs in *Plusia chrysitis*, which is normally crepuscular. Such organs probably have little visual function, *i.e.* they can scarcely be capable of perceiving a useful image, whilst the mere function of discriminating between light and darkness would, one might suppose, be fulfilled as well or better by the large compound eyes so closely adjacent to them.

Nevertheless, as Professor Poulton has suggested, the ocellus is a primitive organ having its own brain connection, and so persisting as a light sensitive organ, even though true vision is now taken over by a new and more complicated structure.

Explanation of Plate XXXIV.

Fig. 1. Lateral view of part of head of *Plusia gamma*.

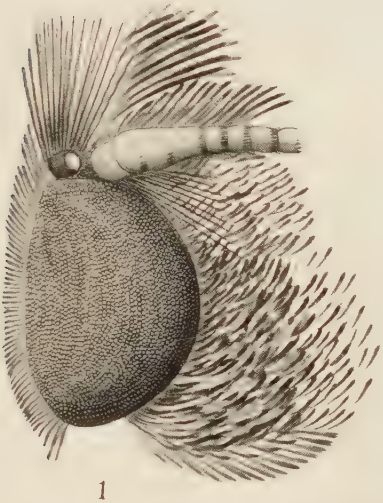
2. Section through the ocellus. *c* outer chitin. *l* lens. *nb* nerve bundles. *nc* nuclei. *m* transverse membrane. *p* pigment cells. *x* a cut nerve fibre. *h* hypoderm.

3. Transverse section of proximal part of nerves.

4. Ditto more distal.

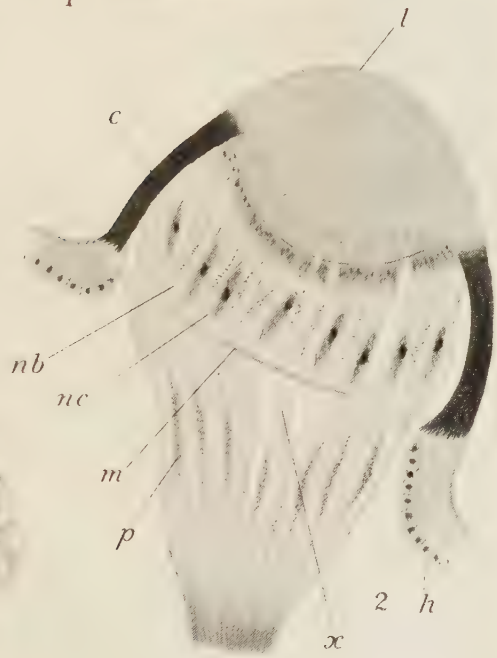
Note.—Diam. of lens, ·124 mm.

„ nerves (fig. 3), ·003 mm.



1

3



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THE OCELLUS IN PLUSIA GAMMA

VIII. *A Revision of the Continental African species of the genus* Artitropa (Lep. Hesperiidae). By N. D. Riley.

[Read March 18th, 1925.]

Plate XXXV.

The genus *Artitropa* was described by Holland (P.Z.S. 1896, p. 92) to include *erinnys* Trimen, *comus* Cramer, *margaritata* Holland, *boseae* Saalm., and *shelleyi* Sharpe, all African species with the exception of the Madagascan *boseae*. References will be found in Holland's paper referred to above, and also in Wytsman's Genera Insectorum, which merely repeats them from Holland, and in Seitz's Gr. Schmett. Vol. XIII. The Madagascan species recently described by Oberthür (*aaron*, *hollandi* and *alaotrana*), and known in this country only from his figures, together with Saalmuller's species, *boseae*, are not included here, as they have been adequately dealt with by Aurivillius in Seitz. With *A. shelleyi* I am not acquainted, nor have I been able to obtain access to the Type specimen; it seems very probable that it does not belong to this genus at all.

Material which has recently been received at the Museum, together with other and more extensive material received by Professor Poulton from Drs. R. and V. G. L. van Someren and from Canon Rogers, and very kindly placed at my disposal, sheds so much more light upon the African species that the following notes would seem not out of place.

1. A. comus Cramer.

(a) *A. comus comus* Cramer.

(Plate XXXV, fig. 1, 1*a* ♂.)

From a careful comparison of the figures of Cramer's *comus*, Drury's *helops*, and Holland's *margaritata*, it is evident that all three represent the female of the West Coast form and are synonymous. The names *comus* and *helops* both date from 1782, but the former has always been given priority, and, in the absence of proof to the contrary, should be retained as the older name. There are specimens in the B.M. from Sierra Leone, the Gold

Coast, and Southern Nigeria, and in the Oxford Museum, from Lagos (S. Nigeria), there is a series of 1 ♂ and 5 ♀♀ bred by Dr. Lamborn. Holland's specimens are said to have come from the Ogowe River, French Congo.

In more eastern localities *A. comus comus* is represented by an easily recognisable subspecies which may be known as

(b) *A. comus reducta* Auriv.

On the upperside this subspecies appears in no way constantly different from *A. comus comus;* the underside, however, is very different. The markings which in *comus comus* are darkest, in *c. reducta* are intensely black, and the colour contrasts consequently much more striking. This no doubt is partly due to the condition of the specimens examined, some of them being bred specimens, but I think not entirely so. The silver markings of the hind-wing, however, present the most obvious differences. The isolated silver spot found in the cell in the ♂ of *comus comus* (joined with the discal transverse band in the ♀) is joined with the much wider and more evenly edged discal transverse band in both sexes in *comus reducta*. In *comus comus* the pale costal spots (in area 8) are greyish; in *c. reducta* they are larger, often partly coalescent, and of the same silvery white colour as the discal transverse band of which the outer one at least forms part. Area 1*b* in *c. comus* is entirely black (or dark brown), in *c. reducta*, however, it is traversed by the discal silvery band so that the dark portion is confined to the margin.

Habitat.—Cameroons: Bitje, Ja River (1 ♂, B.M.). Congo: "Congo" (1 ♂, B.M.); Fayala, R. Wamba (1 ♀, B.M.). Uganda: Ruwenzori (1 ♂, 2 ♀♀, B.M.); Toro, Mpanga Forest (1 ♂, B.M.); Entebbe (1 ♀, B.M.; 2 ♂♂, 1 ♀, Oxford Museum); Jinja (1 ♂, 1 ♀, Oxford Museum). Kenya Colony: Nairobi (1 ♀, B.M.). Nyasaland: Mt. Mlanje (1 ♀, B.M.).

2. A. milleri, sp. nov.

♂.—Readily separable from both *comus* and *erinnys* by the following characters: *Upperside, forewing.*—A conspicuous linear black sex-mark, commencing on vein 1 just proximal to the triangular spot on that vein, runs outwardly, at a slight angle, to vein 2, but is completely broken at about two-thirds the distance across area 1*b*, and by vein 2; from vein 2 it runs almost straight to the point of origin of vein 3, along the basal portion of which,

and of vein 4, it is represented by inconspicuous patches of modified scales. On the *hindwing* a prominent subquadrate orange spot (about 2 mm.) in area 7, towards the margin, is characteristic. *Underside, hindwing.*—The discal area is white, not silvery, and, although continuous to the abdominal margin, is cut off from the spots in areas 7 and 8, except for a narrow transverse white bar in area 6, by a broad irregular black band, extending from the base to the hind margin, and following in the main the direction of vein 7. Fore coxae clothed with long black hair; in *erinnys* and *comus* this hair is ferrugineous buff.

♀.—Similar to the male, but the orange spot in area 7 of hindwing much smaller.

Habitat.—Tanganyika Territory: Tukuyu (*formerly* New Langenburg), 5,000 feet, 5th October, 1924 (*N. C. E. Miller*), 1 ♂ (*Type*); N.W. Rhodesia: Solwezi, 29th April, 1917 (*H. C. Dollman*), 1 ♂; Uganda: E. Ruwenzori, 6–13,000 feet, 27th January, 1906 (*Legge* and *Wollaston*), 1 ♀ (*Type*). B.M.

This species is more likely to be mistaken for *comus* than for *erinnys*, on account of the similarity of the large white discal patch on the underside of the hindwing, but the differences given above should serve to distinguish it. Certain features in the three specimens recorded seem to suggest that each represents a distinct subspecies. In the event of this being confirmed the Tanganyika race from Tukuyu should be regarded as typical.

3. A. erinnys Trimen.

Always distinguishable in all its forms from *A. comus* by the pale central area of underside of hind-wing never being silvery white.

(a) *A. erinnys erinnys* Trimen.

Trimen's description of the typical race is so excellent that it scarcely needs enlarging upon. The orange patch at anal angle of hind-wing above extends along the margin practically uninterrupted at least to vein 6, more prominently in the ♀ than in the ♂; there is seldom any trace of additional orange spotting between the base of the wing and the discal macular band; the general tone of the underside is rather greenish-grey, sometimes purplish-grey, and the discal patch (= the "two white macular bands close together" of Trimen) appears more often to

be pale greyish-ochreous than white, for in only two specimens out of thirteen examined can it be called white.

Habitat.—S. Africa: Natal, Zululand, etc.

(b) *A. erinnys* **nyasae**, ssp. nov.

(Plate XXXV, figs. 2, 2*a* ♂.)

This is a slightly smaller, very much darker race, but with paler, less orange-yellow, narrower and more sharply defined hind-wing discal band, and the marginal yellow line similarly pale and reduced. On the underside the discal patch is white, considerably indented anteriorly by an invasion of the ground-colour at the cell end in the ♂, less so in the ♀; the yellow anal patch confined to the cilia; the general ground-colour dark brown, not tinged with greenish. Hyaline spots of fore-wing larger than in other races.

Habitat.—Nyasaland: Mt. Mlanje (6 ♂♂, 6 ♀♀, including *types*); Zomba (1 ♂); Blantyre (2 ♀♀). B.M.

(c) *A. erinnys* **vansomereni**, ssp. nov.

(Plate XXXV, figs. 3, 3*a* ♂.)

Hyaline markings of fore-wing small, those in areas 2 and 3 well separated; orange band much as in *e. nyasae*, but deep orange in colour; ground-colour very black, orange anal patch of hind-wing well developed and extending to vein 6, but broadly interrupted by black at the extremities of the veins. Underside very dark; the ochreous spot in area 1*b* of fore-wing seldom any larger than its counterpart on the upperside; central pale patch of hind-wing confined to the disc, not entering the cell at all in the ♂, represented in the cell by an isolated spot towards anterior margin in the ♀, much suffused with black scaling (especially in the ♂) and almost entirely obscured in areas 1*a* and 1*b*.

Habitat.—Kenya Colony: Nairobi (*van Someren*) 8 ♂♂, 10 ♀♀, bred Sept. and Oct. 1923 and July, Aug. and Sept. 1924, in Oxford Museum; 3 ♂♂, 5 ♀♀, bred Dec. 1923, in B.M. *Types* in B.M.

Some difference is noticeable between the series of specimens bred in September and October 1923 and that bred in December 1923. The former are decidedly larger, not so black, and with somewhat more extensive orange markings above. In 1924 the specimens which emerged in late July and early August are the largest, those dated late August and September agreeing with the December 1923 specimens. It would seem therefore that the differ-

ences are to be attributed to variations in the conditions under which the insects were bred rather than to any seasonal climatic influences.

(d) *A. erinnys ehlersi* Karsch.

Artitropa ehlersi Karsch, Ent. Nach., XXII, p. 376, 1896.
Artitropa erinnys var. *unifasciata* Auriv., Wiss. Ergeb. Schwed. Zool. Exp. Kilimandjaro-Meru, II, pt. 9, p. 15, 1910.

Karsch compares this race with *comus*. From his description, however, it is quite clear that he refers to a race of *erinnys*, which was subsequently redescribed by Aurivillius as "differing from the S. African form in that the yellow transverse band of the hind-wing upperside reaches the inner margin and is there strongly expanded; that the yellow marginal band extends from the anal angle only as far as vein 2, beyond which both margin and cilia are dark brown; and that on the underside the two whitish discal bands are completely united to form a broad transverse band in which a black spot in area 1*c* is included."

Karsch does not state the sexes of his specimens. Aurivillius had only the ♀. The ♂ differs only in having the central pale patch on the underside of the hind-wing invaded anteriorly by an irregular projection of the ground-colour about the discocellulars.

Habitat.—Tanganyika Territory: Kilimandjaro (1 ♂, 1 ♀, in B.M.; 1 ♀, Oxford Museum, *Rogers*); N. Usambara, Mlalo.

(e) *A. erinnys* **radiata**, ssp. nov.

(Plate XXXV, figs. 4, 4*a* ♀.)

♂ ♀. Most like *A. e. ehlersi*. The transverse orange band of upperside, however, still more extensive, united with the orange anal patch and completely occupying areas 1*a* and 1*b*, sometimes reaching the margin also in area 1*c* in such a way as to leave only a black dash, representing the marginal band, along vein 1*b*; the veins, where they pass through the marginal black band lighter. General coloration of underside rather light grey brown; central patch of hind-wing large, white, reaching abdominal margin very broadly, the marginal band in areas 1*a* and 1*b* consequently reduced in width; the anal area generally strongly tinged with yellowish; the veins conspicuously paler than ground-colour.

Habitat.—Kenya Colony: Sagalla Mt. (*Rogers*), 1 ♂, 5 ♀♀, July, August 1913 (including *types*), 1 ♀, Dec., 1 ♀, Jan. 1914; 1 ♂, Jan. 1915. *Types* ♂ and ♀ in B.M.; remainder in Oxford Museum.

(f) *A. erinnys comorarum* Oberth.

This race, although, as its name implies, not from the mainland of Africa, is included here only in order to render as complete as possible the survey of the species. On the upperside it closely resembles *A. e. radiata*, especially in the extent of the yellow areas of the hindwing. On the underside of the hindwing the discal white patch is broken up into separate spots, and only extends towards the inner margin as far as vein 1*b*.

Habitat.—Grand Comoro.

The preponderance of females in the two species *comus* and *erinnys* is unusual. Of 86 specimens examined 52 are females, only 34 males.

Both species have been bred; *comus* at Jinja in Uganda by Dr. R. van Someren, to whom the discovery of the life-history is due, and also at Lagos by Dr. Lamborn, and *erinnys* at Nairobi by Dr. V. G. L. van Someren, who was led to search for the earlier stages on a food-plant similar to that upon which *A. comus* was found at Jinja. The following extracts are taken from letters written to Professor Poulton by Dr. V. G. L. Someren:—

Artitropa comus. "The eggs when newly laid are a pink colour and, as development goes on, they turn greyish. They are laid singly. Five to eight days elapse before they hatch. The newly hatched larva is yellowish-green with dark head. With each moult the colour changes to a light greenish-white with yellow head with *two black or dark brown spots* (see Plate XXXV, fig. 5). They are voracious feeders and like others of this group rest in curled-up leaves, either naturally curled or leaves with edges approximated and attached with silk. The food-plant is a species of *Dracaena*. The larva pupates in a folded leaf and is attached in the usual way, *i.e.* at the hind end and by a body band. The freshly formed pupa is greenish-white and gradually turns to a dirty pinkish-green covered with a white powdery substance. My specimens emerged in three weeks, but in Uganda they

emerge rather more quickly. The insect is crepuscular and appears to rest during the day. They are not common.

Artitropa erinnys. "The eggs are laid singly for the most part, though two may occasionally be deposited close together. They are laid either on the leaves, upper or under surface, frequently near the base, or on the trunk of *Dracaena reflexa*. They are generally salmon-pink when first laid, but I have seen a female depositing pure white ones. The eggs are hemispherical and attached by the flattened side. There is a slight circular depression on the top, and a series of ridges radiating from the central spot. The eggs turn greyish as development proceeds, and the larvae emerge within 10 days usually, though some carry over for longer periods. The newly hatched larva is 5 mm. long and yellow with a black head. With the second moult the colour changes to a pale greenish-white and the head piece becomes yellow with black spots arranged as shown on Plate XXXV, fig. 6, thus differing from the Uganda race [i.e. *comus*], which has only two spots.

"The larva, even in the early stages, adopts the habit of protecting itself by cutting the edge of a leaf and bending this over, securely fastening it down with silk threads in two or three places; from this tunnel it emerges half out and devours the leaf substance immediately surrounding. On the slightest alarm it withdraws itself into its protective covering. These tactics are adopted throughout the whole larval period—the whole larva is seldom exposed except when changing and reconstructing a tunnel—nevertheless a fair proportion of larvae are parasitised. I have not yet completed the various parasites, but so far two species of ichneumons have been bred out.

"The larva pupates in a tunnel very similar in construction to its 'hide up,' but in addition it spins a fairly close web over the whole of the inside and blocks up the exit with a flimsy web which can be easily torn by the emerging butterfly. The pupa is attached at its anal end and by a body band. A white powdery substance is secreted by the larva during the 24 hours before it finally pupates. The larval period varies according to the freshness of the leaf—between 14 to 20 days, and the pupal stage lasts 20 days or more.

"Judging by the number of eggs, etc., found on one plant one would be led to think that the insect was common,

but although I have kept a sharp lookout, very few imagines have been taken or even seen. They are crepuscular and extremely shy, and rapid in flight."

The differences in the markings of the larval heads noted by Dr. V. G. L. van Someren are confirmed by specimens from other parts of Africa preserved in the Hope Department, Oxford University Museum. Cast skins of *comus* larvae bred at Lagos and received from Dr. Lamborn show the same simple pair of black spots as is exhibited by the Jinja specimens; and a single larval head of *erinnys* from Durban, sent by the late A. D. Miller, similarly exhibits the two pairs of black spots characteristic of the Kenya *erinnys*.

Explanation of Plate XXXV.

Fig. 1. Upperside } of *Artitropa comus comus* Cramer, ♂ from
1*a*. Underside } Lagos.
2. Upperside } of *A. erinnys nyasae* ssp. nov., ♂ from Mt.
2*a*. Underside } Mlanje, Nyasaland.
3. Upperside } of *A. erinnys vansomereni* ssp. nov., ♂ from
3*a*. Underside } Nairobi, Kenya Colony.
4. Upperside } of *A. erinnys radiata* ssp. nov., ♀ from Sagalla
4*a*. Underside } Mt., Kenya Colony.
5. Larval skin of *Artitropa comus* to show the single pair of black spots on the head.
6. Larval skin of *A. erinnys* showing two pairs of black spots and also median black markings on the head.

Photo. E. J. Manly. *Vaus & Crampton, Ltd.*

IX. *The Dispersal of Insects to Spitsbergen.* By C. S. Elton, Dept. of Zoology and Comparative Anatomy, University Museum, Oxford.

[Read March 18th, 1925.]

1. Introduction.
2. The scanty insect fauna of Spitsbergen.
3. Methods of dispersal.
4. Summary.
5. References.

1. Introduction.

This paper contains various observations made by myself and other members of the Oxford University Expeditions to Spitsbergen, during 1921, 1923, and 1924. I wish to thank the following gentlemen, who have kindly given me much information and other help: Messrs. F. G. Binney, W. B. Carslake, H. M. Clutterbuck, F. A. Montague, K. S. Sandford, members of the Oxford sledging parties in 1924, who gave me the data about flies and Aphids on North-East Land; Mr. J. E. Collin, for identifying the flies; Mr. F. Laing, for identifying the Aphids; Mr. E. Koefoed, for notes on flies observed on Hope Island in 1924; Mr. Krogness, for allowing me to consult the weather charts for August 1924, while I was in Tromsö; Dr. Otto Stapf, for information about the distribution of the spruce in Europe. Finally, I wish to express my thanks to Professor E. B. Poulton, for his kind help and encouragement during the preparation of this paper.

2. The Scanty Insect Fauna of Spitsbergen.

The insect fauna of Spitsbergen is remarkably poor. There are only two orders of insects which are present in sufficiently large numbers to provide food for other animals. These are the Diptera (flies, gnats, etc.) and Collembola. The former are mostly Chironomids, with aquatic larvae. In addition to these (see 7) there are three species of beetles, a moth, a sawfly, several species of parasitic Hymenoptera, a caddis-fly, an Aphid, and a certain number of bird and mammal parasites (lice, fleas, and bird-lice). Now the

poverty of this fauna is not only due to its high arctic character, but also to the geographical isolation of Spitsbergen, as a comparison with Greenland in regions of similar climate will show. One notes, for instance, the complete absence of bees, butterflies, and Tipulid flies in Spitsbergen. The recent geological history of the Spitsbergen archipelago appears to be as follows (see Nansen, 6) : the islands were connected to each other and to the continent of Europe by land before the Pleistocene Ice Age, when all these regions sank much below sea-level, with the result that Spitsbergen became isolated from Europe by the Barents Sea. This isolation has remained to the present day. At the time of maximum glaciation the preglacial flora and fauna was wiped out by a thick covering of ice, such as still exists on North-East Land. When the ice retreated, the islands were entirely barren, and inasmuch as there has been no land connection with Europe since that time, the present flora and fauna must have reached them by other means. That this conclusion is correct is shown by the striking gaps in the mammalian fauna of Spitsbergen. The lemming, arctic hare, ermine, and musk-ox are absent, and the only true land mammals are the arctic fox and the reindeer. The last two are known to make long journeys over the sea-ice in winter (in fact it has been proved –see 5—that the Spitsbergen reindeer has come over from Asia), while the other animals do not. There is thus a close analogy between Spitsbergen and Krakatoa, the former having had its flora and fauna blotted out by ice, and the latter by volcanic lava. In both cases the question arises : How has the new fauna got there ?

3. Methods of Dispersal.

There are several methods by which insects might reach Spitsbergen :—

1. Wind, or flight, or both.
2. Driftwood.
3. Drift-ice.
4. Ships.
5. Birds.

These factors will be considered in turn.

1. Wind, or flight, or both.

(*a*) Hover-flies and Aphids on North-East Land, August 1924.

North-East Land is the second largest island of the Spitsbergen group; it is about the same size as Wales, and is almost entirely covered by a thick ice-cap, which rises to some 2300 feet above sea-level. There are patches of barren rocky land round the coast, which possess an exceedingly scanty fauna. The only insects which live on this coast area are a few flies and Collembola.

A very curious case of dispersal on a large scale was met with by the Oxford sledging parties on the ice-cap of North-East Land in August 1924. I myself was not sledging and am therefore indebted for the following facts to members of the various parties, viz. Messrs. F. A. Montague and W. B. Carslake of the Northern Party, Messrs. H. M. Clutterbuck and K. S. Sandford of the Central Party, and Mr. F. G. Binney of the Southern Party. It is worth while giving the detailed experience of these parties, although exact localities, distances and heights are not yet available. (For the present purpose extreme accuracy in these data is unnecessary.)

Northern Party. August 6th. The party were camped on the top of the North-East Land ice-cap, *i.e.* on the N.W. corner of the island, at about 2300 feet above sea-level. There had been light south winds earlier in the day, but at 10 p.m. a strong gale sprang up from the south, and lasted six hours.

August 7th. They were still in the same place, and there was mist and fairly brisk rain with a strong south breeze.

August 8th. The party started to travel towards the south (over old ground traversed a few days before), and after they had gone about two miles, reaching a long south slope, a large black Aphid was seen sitting on the snow. After this, Aphids were met with all day on an eight-mile march south, about one to every thirty or forty yards, either on the level or on a slight south slope. They were resting on the surface of the snow, not buried, and with the wings mostly dry, about 80 per cent. being alive. Specimens of these were collected. During the day one large yellow and black hover-fly was also seen and collected; it was walking on the snow, with the wings more or less dry. Later in the day another hover-fly was also seen, but was rather bedraggled. One specimen of some large Tipulid fly was seen by Mr. Carslake on the snow. The weather during this day was cold, damp, and misty.

August 9th. During this day the party marched five miles south, still high up on the ice-cap, and they saw black Aphids still, but about one-third as thickly, and about 90 per cent. dead. There were no hover-flies.

August 10th. No more insects were observed, and during the day a blizzard came on, which lasted until August 13th. This must have destroyed all the insects.

Central Party. August 5th. The party was encamped near the head of Wahlenberg Bay, a deep fjord running into the west coast of North-East Land; they were about fifteen miles from the north side of the Bay and about 1000 feet up on the ice-cap. (Camp 9 = "Amen Camp.") At this time there were no insects on the snow.

August 6th. A reconnaissance was made, and they returned to camp by 1 p.m., no insects having been seen during the morning. There was a wind from the S.W., and the barometer was falling.

August 7th. Still at Amen Camp. Wind from the S.W. Barometer falling very low. Heavy rain on the night of the 7th.

August 8th. At 1 a.m. Mr. Clutterbuck went out and saw one yellow and black hover-fly sitting on the snow, and secured it. At 7 a.m. the party started to return in a westerly direction along the side of the ice-cap, still at about 1000 feet. Large numbers of hover-flies and black Aphids were seen during the whole of that day, on a march of from five to ten miles. The insects were sitting on the snow, alive but rather sluggish. Another hover-fly and some Aphids were collected. The wind was now rather indefinite.

August 9th. Starting from "Blue Lagoon Camp" (No. 10) the march was continued, but no more hover-flies were seen, although there were still a few black Aphids about.

August 10th. The party left "Ice Cone Camp" (No. 11) in the morning, and saw no more insects. At 2 p.m. they were stopped by a blizzard which lasted for three days, and must have destroyed all the insects.

Southern Party. On the early morning of August 7th (midnight to 8 a.m.) no insects were recorded by Mr. Binney. But while marching at the same time on the 8th (12.30 to 8.30 a.m.) both yellow and black hover-flies and black "flies" were seen. The latter were obviously the Aphids, although no specimens were collected. The place where the insects were seen was on the top of the ice-cap some miles

from the east coast, between Isis Point on the East Coast and Wahlenberg Bay on the west.

I should like to emphasise the fact that these sledging parties were travelling under exceedingly strenuous conditions and over very bad surfaces. This made the collection of specimens and taking of notes no easy task. Therefore the careful and scientific way in which the data about these insects was recorded reflects great credit on the men who did the work.

Base Camp. I myself was working on Reindeer Peninsular, Liefde Bay, North Spitsbergen (about forty miles from North East Land), at this time, and observed no hover-flies or Aphids in a long day's excursion on August 8th. Therefore the fly swarms must have passed to the north-east or else at greater heights.

It is clear from the facts detailed above, that the insects must have arrived on the ice-cap some time during August 7th. All the observations agree with this conclusion. The numbers of these flies and Aphids must have been enormous, running into hundreds of thousands or even millions, for all three parties to have seen so many at the same time. The insects appear to have been blown in a broad belt over the island. Now, where did they come from and how did they get to North-East Land?

The hover-flies (three females) have been identified by Mr. Collin as *Syrphus ribesii* Linn., which is widely distributed in Europe, occurring, amongst other places, in the extreme north of Sweden and in Iceland, but has never been recorded from Spitsbergen or Greenland. The Aphids are winged females, and have been identified by Mr. Laing as *Dilachnus piceae* Pz. (*nec* Walker), the food-plant being the spruce, *Picea* (*P. excelsa*, etc.). Mr. Collin informs me that although there are no actual records of the larva of *Syrphus ribesii* preying upon this Aphid, it is quite likely that it does so. It is only reasonable to suppose that the hover-flies and Aphids came from the same district, in view of their vast numbers and the almost complete absence of other insects in the swarms.

There are no large Tipulids in Spitsbergen. The only *Syrphus* occurring in Spitsbergen is *S. tarsatus* Zett., which lives in a few favoured spots on the west coast of West Spitsbergen (2). With it is found a small species of Aphid (not *Dilachnus piceae*). We know from the work of foreign naturalists in Bellsound and Icefjord, and the ecological

survey carried out by the Oxford Expeditions in Icefjord and other parts of Spitsbergen, that there are no places where *S. ribesii* or *D. piceae* do or could occur. The fact that there are no trees proves that *D. piceae* must have come from some other country. To Dr. O. Stapf, through Professor Poulton, I am indebted for the following information about the distribution of the spruce in Europe :—

"The northern *Picea* of Scandinavia and Russia is *P. obovata*, which is treated by some as a variety of *P. excelsa*. Its northern limit runs from Saltdalen in Norway (67° 10′ N.) over the Sultjelma to the upper Muonio river and thence to Lake Enare and the Kola Peninsula, but there is an outpost in the Varangerfjord (69° 30′ N.) and another at Karasjok (68° 30′ N.). Neither of these outposts is likely to supply those 'immense numbers' of the Aphid you speak of, nor is it likely that they came from the Norwegian coast at Saltdalen or the Swedish stations. At Saltdalen, at any rate, there are only a few trees of it. The tree is much more common in the Kola Peninsula (say at 67° N.), and I would suggest this to be the origin of the Aphid. It does not occur in Novaya Zemlya, which would be perhaps a little nearer."

It is probable then that the Aphids, and therefore presumably the *Syrphi*, came over from the Kola Peninsula to North-East Land, a distance of over 800 miles in a straight line. This idea is confirmed by the following facts about the weather conditions prevailing at this time over Spitsbergen, the Barents Sea and North Europe. During August 6th, 7th, and 8th, there was a very large depression which moved over Spitsbergen from the Atlantic. As a result of this there were strong south and south-east winds blowing from Europe over Spitsbergen and more especially North-East Land. This is precisely what would be required to carry the flies from Kola Peninsula to North-East Land. Mr. Krogness, of the Tromsö Geophysical Institute, kindly allowed me to consult the synoptic charts for these days, and from the wind directions and forces it appeared that the insects would take from twelve to twenty-four hours to do the journey.

This view of the track followed by the insects is confirmed in an interesting way by Mr. Koefoed, who was engaged on fishery research in the Barents Sea in 1924. On August 13th Mr. Koefoed was able to land on Hope Island, a small, rather inaccessible, and extremely barren island belonging

to the Spitsbergen group, and lying between North-East Land and Europe. It is about 250 miles from North Cape in Norway, and some 600 miles from the Kola Peninsula. On the island Mr. Koefoed saw four specimens of a large yellow and black *Syrphus*, walking about over the snow-free ground. One of these was collected, and is now in the possession of Mr. L. Natvig of the Oslo Museum, Norway. The position of Hope Island shows that these flies very likely formed part of the swarms that reached North-East Land on August 7th, and if this is so, they must have remained alive there for over a week.

The cause of these swarms of insects remains to be considered. In August 1869 Dunning (3) recorded "countless swarms of *Syrphi*" at Walton-on-the-Naze, on the Essex coast, and another observer noticed similar swarms at Margate on the same day. The Essex swarms consisted mainly of *S. ribesii*, *S. corollae*, and *S. pyrastri*. It is clear, then, that hover-flies are subject to occasional great increase in numbers. Now, I have shown (4) that the periodic abundance of mammals and birds in Northern Europe is mainly controlled by climatic factors acting at regular intervals. The explanation of the hover-fly swarms may be that good years cause unusual abundance of Aphids, upon which the hover-fly larvae feed. This idea is supported by the North-East Land episode, and also by the fact that ladybirds (*Coccinella 7-punctata* and *bipunctata*) were unusually abundant in Essex and Yorkshire in 1869, since ladybirds, like the hover-flies, feed on Aphids.

It may be noted that Amundsen, while on the north coast of Arctic America, noted (1) the arrival of gnats during a storm from the south-east. This would be a similar case to that of the North-East Land insects.

(*b*) Local migration of *Fucomyia parvula* against the wind.

On July 12th, 1924, examples of the seaweed-fly *Fucomyia parvula* Hal. were found in the shingle above high-tide mark, near the Expedition's Base Camp (south side of Reindeer Peninsula, Liefde Bay, North Spitsbergen). On this day none were flying, and they were hiding under the stones, and when exposed to light crawled at once very actively down into cracks among the stones, although the wings were expanded. The air temperature was about 10° C. in the shade, and the weather was cold and cloudy.

On July 23rd, *i.e.* eleven days later, numbers of these flies could be seen near the shore, flying quite fast against

a light south wind. (One or two could also be seen being blown very fast in the opposite direction.) The sun was shining, and it felt quite hot, although the air temperature was only about 5° C. in the shade. The migration had no relation to the position of the flies' normal habitat (drifted seaweed).

Clearly the reactions of the flies to light had changed from positive to negative between July 12th and 23rd. A similar reversal of phototropism was noticed on board the expedition ship "Polarbjorn" in the case of the fly *Leria modesta* Mg. The larvae were living among herring refuse in the ship's hold, and began to pupate in large numbers in July. On July 26th there were large numbers of newly emerged adults, hiding in the darkest corners, some with wings still unexpanded. On July 27th they were flying about outside in the sun. In the case of *Fucomyia* the reversal of phototropism was probably due to rise in insolation temperature, since in the arctic this is far more important than air temperature; in the case of *Leria*, to the changed physiological state of the flies. These examples illustrate how the reactions of insects may be reversed in nature by change in the animal or in the environment. Similar changes seem to occur on a much larger scale in locusts, causing them to migrate. It does not seem unreasonable to suggest that unusual climatic conditions in certain years may cause locusts to migrate in the same way that seasonal changes did in the *Fucomyia*, by reversing the normal tropisms.

(*c*) Local migration of blowflies.

Blowflies do not usually occur in Spitsbergen except near the coal settlements, and they have probably been brought there by ships. On July 3rd, 1924, numbers of blowflies (*Phormia groenlandica* Zett.) were found emerging from the carcase of a whale at Green Harbour, in Icefjord. On July 5th several examples were seen flying past at a distance of one to two miles from the whale, while dozens were to be seen flying round the carcase itself.

(*d*) Local migration of Chironomid flies.

On sunny days in the summer one usually sees a good many Chironomids flying along singly, and this habit of "voluntary migration" seems to be common to many species, e.g. *Diamesa poultoni* Edw., flying over snow-covered ground in early July 1921, on Prince Charles Foreland, and also at Green Harbour.

2. Driftwood.

Quantities of driftwood are carried by the polar current over to Spitsbergen, from the north of Europe and Siberia. I have never succeeded in finding anything living in it, but it may occasionally act as a dispersal agent. Logs become frozen into the ice pack, and animals or their resting stages might thus be transported long distances without being in contact with salt water.

3. Drift-ice.

The same drift that carried the wood, carried the pack-ice from Siberia to Spitsbergen. Collembola might be carried on ice-floes, since some species, e.g. *Agrenia bidenticulata*, are in the habit of walking out over snowfields (probably in order to eat wind-blown pollen).

4. Ships.

The sealing ships which visit Spitsbergen carry with them a small insect fauna. On the "Terningen" (1923) were a good many flies (*Leria modesta* Mg.). On the "Polarbjorn" (1924) were several species of flies (*Leria*, *Limosina* and blowflies), a beetle (*Enicmus*) and a spider (*Leptyphantes leprosus* Ohl.). The flies breed in the remains of herrings which are carried as cargo in the winter months to the Roman Catholic countries of southern Europe. The spider lives on the *Limosina*. It is thus apparent that the dispersal of insects to Spitsbergen is partly dependent on religious movements. So far, however, none of these species seem to have established themselves in Spitsbergen, except blowflies.

5. Birds.

(*a*) The insects transported to Spitsbergen by birds include a flea (*Ceratophyllus vagabundus* Bohem.), occurring in the down of goose nests and possibly reintroduced every summer), and numerous mallophaga living on birds themselves.

(*b*) Birds may sometimes assist in the dispersal of free-living insects. On Bear Island during June 1921, kittiwake gulls could be seen carrying lumps of moss for some miles to their nesting cliffs. In their nests a good many flies and Collembola occur, which have obviously been brought there by the gulls in the moss.

(*c*) At Salmon Lake, Wijde Bay, North Spitsbergen, there is a colony of Arctic Terns, which nest on some of the small islands in the lake. On these islands in August 1924 there were enormous numbers of a mite, *Bdella littoralis* Linn. Now this mite normally occurs only at or

below high-tide mark on the seashore, where it is very common. Here it was living on islands in a freshwater lake. Further, it occurred only on those islands where the terns were nesting, and not on the others. Since Arctic Terns often settle on, or nest on, shingle near the shore, where *B. littoralis* abounds, running about actively over the stones, it seems certain that the mites must have been accidentally carried to the islands by terns. This example illustrates the manner in which insects, *e.g.* Collembola, might also be dispersed by birds.

Conclusion.

The concrete examples given above would make it appear that wind, flight, birds, and ships, are mainly responsible for the dispersal of the present fauna of insects to Spitsbergen. In the case of insects like flies, "voluntary migration" seems to play an important part, just as among butterflies and locusts.

4. Summary.

1. The insect fauna of Spitsbergen is very scanty.
2. This scantiness is due to the high arctic character of the islands and to geographical isolation from Europe by sea.
3. The possible methods of dispersal of insects to Spitsbergen are :

(1) Wind, or flight, or both, (2) Driftwood, (3) Drift-ice, (4) Ships, (5) Birds.

4. Examples of the action of some of these factors are given :—

(*a*) *Syrphus ribesii* and *Dilachnus piceae* and *Tipulid* fly, blown to North-East Land from Europe.
(*b*) Local "voluntary migration" of *Fucomyia frigida*, blowflies, and Chironomid flies.
(*c*) Fleas, mallophaga on birds.
(*d*) Gulls carrying insects in moss.
(*e*) Mites (*Bdella littoralis*) transported by Arctic Terns.

5. References.

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X. *New Geometridae from Madagascar in the Collection of Sir George H. Kenrick.* By Louis B. Prout, F.E.S.

[Read March 18th, 1925.]

Plate XXXVI.

The extremely interesting Geometridae described in this paper were all collected by Mr. F. B. Pratt in the mountains of Central Madagascar, at an altitude of about 2500 feet, January-March 1911, and have been entrusted to me to work out. It has not been possible, under the pressure of other work, to deal exhaustively with the very fine collection obtained, and it is probable that a few novelties may have been accidentally overlooked in addition to the few which have been intentionally put aside on account of condition or other difficulties. One or two species, again, are being described by me from better material in the Tring Museum, and the Pratt specimens will be mentioned in those descriptions. There remain, however, twenty-nine novelties, mostly very striking, to be described here. Only the last of them, *Psilocerea scordamyctes*, has been crowded out from the plate which has been prepared by my sister, Miss A. E. Prout; and this, with its simple pattern and characteristic bicoloured cell-dot, will be easily recognised from the description.

Very noteworthy are the endemic group for which I have erected the new genus *Blechroneromia* and the numerous and very diversified species of the beautiful genus *Ptochophyle*.

Subfam. HEMITHEINAE.

1. **Archichlora chariessa**, sp. n. (Fig. 8.)

♂, 25 mm.; ♀, 36 mm. Near *engenes* Prout (Nov. Zool., xxix. 328). Face more mixed with red. Vertex and antenna without the red and black admixture. Pectinations in the ♀ little shorter than in the ♂.

Fore-wing slightly bluer green than in *engenes*; costal margin broadly pale, only with a very slight and sparse sprinkling of dark scales; a hind-marginal pale patch before middle, in the ♂ small and obelisk-shaped, in the ♀ larger and broader; a pale distal border, less expanded tornally than in *engenes*, much less constricted in

middle, traversed by an irregular, sometimes interrupted band of brownish shading. *Hind-wing* with the tooth at R^1 rather less pronounced than in *engenes*; border correspondingly modified to that of fore-wing.

Underside similar to that of *engenes* except for the altered form of the distal borders.

The ♀ has the costal margin of the hind-wing appreciably expanded at the base, and I cannot find a frenulum; this strengthens the suspicion which I have entertained that the genera *Archichlora* and *Bathycolpodes* furnish a series of transitions between my Groups IV and V of the *Hemitheinae* (Gen. Ins., cxxix).

2. **Leptocolpia oxygonia,** sp. n. (Fig. 1.)

♂, 34 mm. Face brown, at sides blackish. Palpus very short, rough-haired, black. Head and body coloured almost as in *viridicatena* Prout (the "patagia"—recte tegulae, cf. Tams, Journ. Nat. Hist. Soc. Siam, vi. 230—and band at base of abdomen in both species green, perhaps a shade deeper in *oxygonia*).

Fore-wing with costa straighter than in the type species, angle at R^1 acutely produced; *DC* very deeply inbent; SC^1 anastomosing with SC^2 but not with *C*; coloration almost exactly as in *viridicatena*, the ground-colour slightly paler; the band slightly deeper or more bluish-green, not interrupted, slender between *M* and fold, expanding greatly anteriorly, touching the cell-dot proximally, nearly reaching the apex distally, but cut near its end by a white mark between SC^4 and R^1.—*Hind-wing* totally different in shape from that of *viridicatena*, being much less long in middle, but more prolonged to tornus, the tooth at R^1 absolutely rudimentary; M^1 shortly stalked; the black cell-mark more elongate; the green band beyond it extremely narrow; some green strigulae and dashes elsewhere; postmedian band broad but very ill-defined, subdiaphanous rather than white.

Underside much less irrorated than in *viridicatena*; cell-spots as above, or on hind-wing stronger still; a straight brown postmedian line on hind-wing, not reaching abdominal margin; outer dark band of hind-wing strong anteriorly (marked with whitish spots in cells), almost obsolete posteriorly.

The details of venation will certainly vary as in most *Hemitheinae*. A large form of *viridicatena* in coll. Kenrick (Central Madasgacar, *F. B. Pratt*) has SC^1 of fore-wing well free from both *C* and SC^2.

3. **Hypocoela spodozona,** sp. n. (Fig. 2.)

♂, 35 mm. Head, thorax and base of abdomen green, the face becoming tinged with ochreous below; palpus 1¼, bright orange-ochreous, above somewhat mixed with grey, on outer side with reddish. Antennal shaft blackish, pectinations ochreous, rather long (only a stump remaining). Abdomen with 2nd and 3rd tergites red-brown, bearing moderate black crests. Body beneath bright ochreous. Legs bright ochreous, the tarsi and fore- and mid-tibia infuscated except on underside.

Fore-wing with termen not excised behind apex, slightly more oblique than in *subfulva* Warr.; SC^1 free, M^1 almost connate; slightly brighter green than *subfulva*; a faint reddish, black-dotted cloud behind base of cell; an irregular median band of coarse black irroration, widening at costa, forming a longitudinal streak behind proximal part of SC^5, almost obsolete proximally to this spot; a subterminal band of white lunules or V-marks between the veins, in submedian area forming a W; some slight reddish irroration edging the subterminal; some slight black irroration at termen; fringe predominantly black.—*Hind-wing* with termen in middle rather straighter than in *subfulva*; green, at costal margin suffused with ochreous; some slight dark irroration anteriorly and proximally; a small cell-dot; a blackish dash on abdominal margin opposite the crested somites; fringe blackish.

Underside green, suffused (especially on fore-wing posteriorly and on hind-wing excepting a terminal band) with orange-ochreous; costal edge of fore-wing orange-ochreous; irroration rather stronger than above; subterminal of fore-wing represented by blackish spots, the posterior two the largest and blackest.

4. **Hypocoela drepana,** sp. n. (Fig. 3.)

♂, 31 mm. Head red; vertex pure white. Palpus reddish. Antennal shaft pale, proximally whitish; pectinations about 3; light-brown. Thorax and abdomen above red-brown (the thorax in front redder, otherwise more purplish); beneath paler and more ochreous brown.

Fore-wing with apex still more falcate than in *humidaria* Swinh.; SC^1 free; proximal area dull purple (reddish purple mixed with purple-blackish), limited by an indistinct, sinuous yellowish line; succeeding area paler; a rather narrow median band of bright red-brown, its distal edge slightly incurved between the radials and more deeply between R^3 and SM^2; a black cell-dot on this band; distal area mostly pale, anteriorly more tinged with ochreous, otherwise with violaceous; elongate dark subterminal spots between

SC^5 and M^2 (mostly black, proximally red-brown), accompanied by some ochreous-brown shading; some terminal dark shading except apically. *Hind-wing* more uniform red-brown, only with the costal area pale and a pale postmedian line, twice incurved like that of the fore-wing.

Underside predominantly bright reddish orange; fore-wing with costal margin (except at base) and apex pale buff, hind-marginal area whitish; hind-wing with the colour becoming paler proximally (except at costa).

Blechroneromia gen. n.

Face smooth. Palpus short, with moderately appressed scales; terminal joint in both sexes small, nearly concealed. Tongue present. Antenna in both sexes bipectinate, the last few joints merely ciliate. Pectus hairy. Femora not hairy. Hind tibia in ♂ moderately stout, but not dilated; in both sexes with terminal spurs only. Abdomen scarcely crested. Frenulum in ♂ from before basal expansion of hing-wing; in ♀ vestigial. Wings typically rather thinly scaled.

Fore-wing with termen smooth; cell rather less than one-half. DC inbent, posteriorly strongly oblique; SC^1 from near $SC^{2\text{-}5}$ (in *anthosyne* connate), SC^2 stalked but before SC^5, R^1 connate or shortly stalked, M^1 separate. *Hind-wing* with termen waved or almost smooth, rounded, tornus rather sharp; cell less than one-half, DC^3 oblique (very so in *mianta* ♂, *eluta* and *anthosyne*), C shortly approximated to SC near base, rather rapidly diverging, SC^2 stalked, M^1 separate.

Type of the genus: *Blechroneromia mianta* Prout, sp. n.

Intermediate between *Neromia* and *Neurotoca*, differing from the former in the strongly pectinate antennae, etc., from the latter in the less minute palpi, developed tongue, etc. The more typical species have somewhat the facies of the *Blechroma* group of *Racheospila*.

5. **Blechroneromia mianta,** sp. n. (Fig. 4.)

♂, 37 mm.; ♀, 43 mm. Face green, paler below. Palpus blackish, beneath white. Vertex and antennal shaft white; pectinations of the outer (longer) series in ♂ 4–5, in ♀ nearly 3. Occiput green. Thorax above green, on metathorax blackish, beneath white. Abdomen above green on first two segments, then blackish, at anal end and beneath white; no appreciable crests. Legs white, fore-leg marked with blackish.

Fore-wing green; costal edge white; markings blackish fuscous, formed of confluent irroration; a patch at base; a roundish cell-

dot larger and more ocellated in the ♀); a large, irregular subapical patch; a variable tornal one (large in the ♀); vein-dots at termen, on M^1, R^2 and sometimes R^1, additional rather larger) subterminal ones closely approximated to the terminal; fringe paler, weakly spotted opposite the veins.—*Hind-wings* with similar cell-dot; basal patch slight; subterminal patches between the radials and at abdominal margin; ♀ with an additional patch on middle of abdominal margin; termen and fringe as on fore-wing.

Underside whitish green.

6. **Blechroneromia eluta,** sp. n. (Fig. 5.)

♂. 34 mm. Very near the preceding species. Face whiter below. Thorax and abdomen without blackish marking.

Fore-wing with termen anteriorly slightly less oblique; ground-colour paler, more diaphanous; markings browner, more shadowy; a very small basal patch, posterior only; antemedian spots midway between this and cell-dot, the one at fold displaced distally; large subterminal spots between the subapical and subtornal blotches; others closer to termen.—*Hind-wing* with termen slightly more waved than in *miranta*, straighter (or slightly inclining to concavity) between the radials; outer band and spots confluent, though highly irregular; antemedian band strongly developed at abdominal margin, discernible in posterior half of cell.

Underside little paler, the markings showing through.

7. **Blechroneromia perileuca,** sp. n. (Fig. 6.)

♂, 32 mm. Face green above, white below. Palpus red-brown, beneath whitish. Vertex and antennal shaft white; outer pectinations about 6. Occiput green. Thorax and anterior part of abdomen green above, the abdomen with pure white spots scarcely embossed, on anterior part of segments 3 and 4, the former small, edged with red on either side, the latter large; body beneath white. Legs white, the fore-leg shaded with red-brown on inner side.

Fore-wing with the termen slightly straighter and more oblique than in the two preceding; rather brighter green, tolerably opaquely scaled; costal margin snow-white, at extreme base tinged with red; a minute red cell-dot; antemedian line faintly grey, deeply and irregularly dentate, accentuated by darker vein-dots; postmedian expressed by blackish vein-dots or minute dashes, those on R^2 and fold strongly displaced proximally; minute terminal vein-dots, mixed black and red; fringe whitish.—*Hind-wing* without first line; otherwise similar.

Underside whitish green, both wings with costal edge and fringes white.

8. **Blechroneromia anthosyne,** sp. n. (Fig. 7.)

♀, 40 mm. Face green above, pale yellow below. Palpus reddish, pale beneath. Vertex broadly white, occiput narrowly green. Antennal shaft white; pectinations scarcely over 2, ending in fine short bristles. Thorax above green, the metathorax partly pinkish. Abdomen rather robust; above green at base, then pinkish, here sprinkled (especially on the earlier segments) with black and bearing slightly raised white dorsal spots (only the first three well developed). Body beneath whitish. Legs whitish, the fore-leg tinged with red on innerside and with a little black irroration, especially at the knee.

Fore-wing with costa slightly more arched than in the other species; scaling more opaque; bright green; costal edge white, at base red; cell-dot small, black, slightly edged with reddish; lines represented by small white vein-dots; antemedian extremely inconspicuous, accompanied distally by a few black and reddish scales; postmedian very slightly incurved at R^2 and again posteriorly, accompanied distally by a very few black and reddish scales; a fine red terminal line, with white dots at the veins; fringe whitish, weakly spotted with red opposite the veins.—*Hind-wing* with cell-dot and postmedian dots as on forewing ; a very pale pink patch on middle of abdominal margin, bordered anteriorly by a curved red, black-irrorated line, which nearly reaches the base of M^2; termen and fringe as on fore-wing.

Underside whitish green; costal edge of fore-wing yellowish, at base red; hind-wing with the hind-marginal blotch faintly indicated.

The type has lost both hind-legs; should these prove to have four spurs, the species will be referable to *Heterorachis*, probably akin to *malachitica* Saalm.

9. **Xanthodura** (?) **hypocrypta,** sp. n. (Fig. 14.)

♀, 20 mm. Palpus slender, about 1¼, the terminal joint relatively rather long. Antenna pectinate, the branches about 2. (Hind-legs lost). Head and body ochre-yellow, the body beneath paler.

Fore-wing with SC^1 from cell, anastomosing with C and with SC^2, M^1 arising close to R^3; ochre-yellow, with irregular grey-brown irroration, which is strongest in cell, in median area (except costally) and in parts of terminal area and leaves free a patch behind cell; markings of the same grey-brown; an ill-defined cell-ring; both lines rather thick and highly sinuous; antemedian obsolescent costally, in the cell approximated to cell-spot, then crossing base of M^2, excurved to fold, deeply inbent at SM^2; postmedian oblique outward from costa, rather blurred anteriorly, incurved between the

radials and again deeply at fold, strongly excurved between.—*Hind-wing* with frenulum vestigial; SC^2–R^1 better stalked than in the genotype; irroration less pronounced than in fore-wing; cell-mark and postmedian line similar.

Underside without the irroration and markings; fore-wing with a dull purple apical patch of dense irroration, its proximal edge running from costa 4 mm. from apex to termen just in front of M^2.

Probably quite isolated from all known species. Its temporary reference to *Xanthodura* is in a measure arbitrary, but it would fall there by my key (Gen. Ins., cxxix, 14), with the substitution of "yellow" for "deep golden" and most of the given characters agree, while the dark apical patch may further indicate some real affinity. Yet the size, shape and maculation of the upperside are quite different, as is also the point of origin of SC^1 of the fore-wing.

10. **Ptochophyle orthogramma,** sp. n. (Fig. 9.)

♀, 23 mm. Head and body concolorous with wings, the abdomen above becoming a little paler towards the extremity. Legs slightly paler and more ochreous.

Fore-wing chocolate; cell-spot blackish, not sharp; lines slender, straight, yellowish; antemedian at about 3 mm., obsolete before SC^1 and almost so behind SM^2; postmedian less oblique than termen, rather faint at extremities; slight indications of a subterminal in anterior half.—*Hind-wing* with termen little bent; M^1 connate; a white cell-dash; the lines of fore-wing continued, the postmedian very slightly curved.

Underside less dark, more rosy; faint indications of the postmedian line.

Curiously suggestive superficially of some South American *Semaeopus*, sect. *Dichromatopodia*.

11. **Ptochophyle peristoecha,** sp. n. (Fig. 15.)

♂, 25 mm. Face dull purple. Palpus very short and slender; more reddish, beneath whitish buff. Fillet and antenna whitish buff; crown ochre-yellow. Thorax and abdomen above yellow, clouded with red; beneath pale buff. Fore-leg reddened in front.

Fore-wing with areole rather long and narrow; SC^5 arising unusually little before SC^2, M^1 well separate from R^3; yellow, in places (especially proximally and apically) with reddish irroration or minute strigulation; markings reddish; a cloudy subbasal fascia; antemedian and postmedian formed of vein-dots, the

of a close irroration of whitish buff and deep ferruginous; costal and distal margins light vinaceous-drab; a narrow, ill-defined, slightly sinuous vinaceous-drab median shade, separated by a reddish line from the elongate whitish cell-mark; a not very conspicuous, irregularly dentate and zigzag (strongly outbent between R^2 and M^2), slightly interrupted subterminal line of pale yellow, outlined with reddish; similar or more macular subapical marks between costa and the terminal bend; terminal line reddish, simple from tornus to M^1, interrupted at the bend, from R^1 forward lunulate, the lunules increasing in size, the anterior three enclosing yellow terminal spots.—*Hind-wing* with termen strongly bent at R^3; M^1 very shortly stalked; markings much as in fore-wing, the subterminal less oblique anteriorly, very obtusely angled at R^1.

Underside considerably paler; similar markings traceable, the grey median shade relatively rather conspicuous.

16. **Ptochophyle polyniphes,** sp. n. (Fig. 18.)

♂, 20 mm. Head brick-red. Thorax and abdomen above brick-red, with a series of large mediodorsal white spots; laterally and ventrally whitish. Legs whitish, the fore-leg strongly, the mid-leg moderately marked with reddish.

Fore-wing with areole rather long and narrow; SC^1 stalked slightly beyond it; brick-red with dark suffusion, the costal margin more tinged with violet-grey, its extreme edge mostly buff; a number of large, rather irregularly disposed, interneural white spots, some smaller ones and a few sinuous strigulae; fringe pale, the ground-colour encroaching a little at the vein-ends, especially at R^3.—*Hind-wings* with termen bluntly bent; M^1 well stalked; as fore-wing, except costally.

Underside with the ground-colour mostly paler, deepest in and in front of cell of fore-wing, white behind cell, except close to the vein (M); most of the white spots as above.

17. **Ptochophyle kenricki,** sp. n. (Fig. 12.)

♂, 20–21 mm. Face red. Palpus very short and slender; reddish. Vertex and antennal shaft white; pectinations very long. Occiput red. Thorax and abdomen above concolorous with wings, the thorax predominantly purple; abdomen beneath white. Fore-leg reddened (mid- and hind-legs lost).

Fore-wing with costa distally rather straight, apex rather acute, termen very faintly sinuous; areole rather long and narrow; SC^1 stalked well beyond it; pomegranate-purple, mottled with dusky brown, which becomes predominant (and centrally almost black) in

distal area; three yellow marks at costa, the antemedian and the distal flattened, the postmedian much larger, subtriangular, succeeded by a snow-white band between R^1 and M^2, which is constricted between R^3 and M^1 at their base; a fine yellow dash from costal mark to R^1, indicating the subterminal; two pairs of snow-white dashes close to termen (at R^2 and at M^2), each with the anterior dash the longer, and each followed posteriorly by a minute dot; a thick yellow terminal line, widening further in posterior half; fringe yellowish.—*Hind-wing* with termen strongly bent in middle; M^1 well stalked; concolorous with fore-wing; the white markings restricted to a small paired cell-mark and very small subterminal pairs; termen as broadly yellow as on posterior part of fore-wing.

Fore-wing beneath pink, becoming paler and more vinaceous terminally and posteriorly; hind-wing of the latter shade; markings as above, the subterminals confluent with a white terminal band.

18. **Anisodes metamorpha,** sp. n. (Fig. 23.)

♂♀, 36–40 mm. Face dull purple-red, narrowly whitish ochreous below. Palpus with third joint in both sexes long; purple-red, beneath pale. Vertex and antennal shaft strongly suffused with blackish. Collar ochreous. Thorax and abdomen concolorous with wings. Mid-femur of ♂ with long-projecting fringe of ochreous sex-scaling below; hind-femur and base of tibia in ♂ with still heavier ochreous tufting, the tibia with a short proximal and an unequal pair of long terminal spurs.

Fore-wing with apex minutely produced, termen slightly waved anteriorly to R^3, smoother and more oblique posteriorly; vinaceous cinnamon, with minute but copious olive-grey irroration; costal margin blackish; a small and feeble, light-pupilled discal ocellus; antemedian line obsolete; median shade very indistinct, at least as distal as in the *leonaria* Walk. group, similarly formed, but more oblique outward anteriorly; a broad oval or nearly round pale patch beyond it between the dark costa and R^3, reaching well beyond the postmedian and sometimes confluent with smaller pale patches at apex and mid-termen; postmedian line indicated by dark vein-dots; terminal line accentuated by black dots at the veins.—*Hind-wing* with termen not very strongly convex, its anterior part slightly waved, its posterior scarcely; cell-dot white, minute; median shade feebly indicated; postmedian vein-dots present, strongest anteriorly, where there is a pale patch correlated to that of fore-wing; some irregular pale subterminal and terminal spots; terminal line as on fore-wing.

Underside paler, feebly marked.

Central Madagascar (*F. B. Pratt*), type ♂ and allotype ♀. Also a series from North Madagascar, Diego Suarez (*G. Melou*) in Tring Mus.

Variable, some specimens more clouded than others, the pale patches often only feebly indicated. In one ♂ the ground-colour is more chocolate and the pale patches (including base of fore-wing, tornus of hind-wing and a macular subterminal half-band on hind-wing anteriorly) are almost white. The species belongs to the section *Pisoraca*, but the more specialised leg structure is quite distinctive.

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19. **Hypochrosis azalea,** sp. n. (Fig. 13.)

♂, 32 mm. Face above purplish, below orange-ochreous, mixed with red. Palpus over 1¼; ochreous, reddened on upperside. Vertex mixed purple and blackish. Antenna dark. Collar reddish. Body orange-ochreous. Fore-leg mixed with red. Hind-leg pale.

Fore-wing with apex acute, but scarcely produced; termen virtually straight; cell long, especially anteriorly, *DC* being oblique inward from R^2 (which is considerably before middle) to cell-fold; orange-ochreous; some faint and sparse dark irroration; a black cell-dot on DC^2; an indistinct reddish line from two-thirds hind margin obliquely towards apex, but becoming obsolete at anterior end; a still fainter suggestion of a less strongly oblique, anteriorly curved antemedian.—*Hind-wing* with costa elongate, termen little rounded; paler anteriorly, concolorous with fore-wing posteriorly; the cell-dot grey; the postmedian line placed little beyond, least weak at abdominal margin.

Underside rather yellower. Fore-wing anteriorly more strongly irrorate, posteriorly pale and weakly marked; proximal area with rosy suffusion, anteriorly mixed with blackish; cell-dot somewhat elongate, red-mixed; postmedian line brighter and more distinct than above, somewhat diffused distally, angled about R^1, ending in an apical-costal suffusion. Hind-wing with some rosy irroration costally; cell-dot slightly elongate; postmedian bright, complete, slightly diffused distally.

20. **Hypochrosis hypostigmica,** sp. n. (Fig. 20.)

♂, 28 mm. Near the preceding species. Palpus slightly shorter.

Fore-wing with termen less oblique, cell slightly less long; colour a little deeper and more uniform, the markings obsolete, except some extremely minute and sparse irroration; fringe tipped with

dark reddish. - *Hind-wing* with costa less elongate than in *azalea*, termen rounded; markings obsolete.

Underside also nearly uniform orange, with a few scattered blackish scales; both wings with black cell-dot; fore-wing with base of costa mixed with black-grey, apical region with the blackish scales less sparse than elsewhere.

21. **Hypochrosis teleutaea,** sp. n. (Fig. 19.)

♂, 30 mm. Head and body orange. Palpus very little over 1, above reddish, the small, pointed third joint black. Antenna blackish, pectinations very long.

Fore-wing broad, costa arched; SC^1 anastomosing well with C^1 (not connected), R^2 central; cadmium yellow, clouded with orange, the costal and distal regions rather paler yellow; cell-dot small, black; lines reddish, not very strong; antemedian curved; postmedian oblique outward from hind margin, faintly curved, lost about R^3 in a small black-grey apical patch.—*Hind-wing* unicolorous, except for the slightly paler margins.

Underside a little paler; fore-wing with cell-dot strong, lines wanting, apical patch well developed.

Aberrant in shape and venation, but I know of no other genus to which it can well be assigned.

22. **Luxiaria pratti,** sp. n. (Fig. 24.)

♂ ♀, 38–40 mm. Near *taeniata* Warr. (Nov. Zool., iv, 109 = *Calletaera ansorgei* Warr., Nov. Zool., x, 275, syn. n.), but abundantly distinct. Larger. The ♂ pectinations of the outer series a trifle longer.

Fore-wing with apex acuter, termen faintly concave between apex and R^3; costal spots blackened; markings sharper; postmedian line more incurved and blackened between M^2 and SM^2; terminal line less rudimentary, though still extremely fine. -*Hind-wing* more angled at R^3; markings sharper.

Both wings beneath with the band outside the postmedian brighter (more tawny, recalling some Indian *Luxiaria*), the terminal area of the fore-wing more uniformly coloured, without either the white anterior and posterior patches or the dark one between the radials.

23. **Ectropis annumerata,** sp. n. (Fig. 21.)

♀, 26–27 mm. Face pale brown, with slight fuscous suffusion. Palpus 1¼, rather stoutly scaled and blunt, terminal joint concealed; pale at base, shaded with fuscous on outer side. Vertex

and front of thorax light brown, tinged with ochreous; thorax behind and abdomen more whitish, with fuscous irroration. Legs partly darkened (especially the first pair), whitish at ends of joints.

Fore-wing not very broad, termen smooth; $SC^{1,2}$ shortly stalked, SC^2 anastomosing slightly with C; white, with fuscous irroration; basal and distal areas (in an aberration also the median area) strongly suffused with brown; lines black, thickest at costa; antemedian curved, weakening posteriorly; postmedian finely denticulate on the veins, gently bicurved (outward between SC^5 and M^1, inward between M^1 and SM^2); a brown median shade, thickening anteriorly to absorb the black cell-spot; subterminal line crenulate and somewhat zigzag, running inward (but weakened) from R^2 to R^3, less oblique than termen and somewhat thickened from R^3 to behind M^1; a black shade proximal to it, also distally about the radial area; apex and mid-termen more or less relieved with white; terminal spots black; fringe white at apex, then weakly chequered.—*Hind-wing* with termen crenulate, at least in middle; base white, the rest more or less suffused with brown; cell-spot slightly elongate; median line indicated proximally; postmedian little beyond cell-spot, slightly sinuous, at hind margin very oblique outward; proximal shade of subterminal less black than on fore-wing; terminal spots preceded by some slight white maculation.

Both wings beneath with some variable smoky suffusion in proximal half; cell-spots sharp; principal lines present; broad blackish borders, almost reaching the postmedian anteriorly; fore-wing with whitish apical spot and traces of mid-terminal.

Near *sublutea* Butl. (Ann. Mag. Nat. Hist. (5), v. 392) and *prospila* Prout (Nov. Zool., xxiii. 282), both of which have $SC^{1,2}$ of fore-wing coincident.

24. **Cleora emphona,** sp. n. (Fig. 27.)

♂. 34 mm. Face slightly rough-scaled. Palpus nearly 1½, first joint with long loose scaling, second joint with dense projecting scaling above and beneath, third joint small, concealed. Tongue developed. Antenna minutely ciliated. Head whitish, shaded with light brown and with a few black scales. Thorax apparently variegated (partly denuded), the patagia and tegulae predominantly white. Abdomen rather robust; brown, slightly mottled with whitish and with some black scales. Legs darkened (especially the first pair), ringed with white.

Fore-wing not broad, termen almost smooth; $SC^{1,2}$ shortly stalked; white, with pale brown and (very sparse) black irroration;

a curved antemedian line of black irroration, with some brown shading proximally; a heavy black bar across end of cell, meeting the postmedian behind M^1; a heavy brown and black border from postmedian to termen, blackest between postmedian and subterminal, mixed with white at apex and (slightly) at mid-termen, blackened again between the radials; the subterminal faint, crenulate; termen with black interneural dots; fringe chequered white and brown. —*Hind-wing* with termen somewhat crenulate, especially anteriorly; proximal half predominantly whitish; median band broadest posteriorly, tapering to *SC*, then evanescent; a cell-mark just beyond it; postmedian line punctiform, very slightly sinuous; terminal brown border scarcely shaded with black except in a narrow band proximally to subterminal.

Underside rather less white, the blackish borders nearly uniform, more solid, except for pale apical spot on fore-wing and mid-terminal on both wings; cell-mark of hind-wing stronger.

Will perhaps prove an *Ectropis*.

25. **Cleora euplates,** sp. n. (Fig. 26.)

♂, **34 mm.** Face almost smooth. Palpus moderate, second joint with close scaling, third joint distinct, pointed. Tongue slight (? wanting). Antenna bipectinate nearly to apex, the longest branches 4 or 5; fine single bristles on the extremities of the pectinations. Head and body brown, the thorax mixed with white, the occiput and more or less developed posterior belts on the abdominal tergites white. Palpus and fore-leg somewhat darkened.

Fore-wing broad, termen smooth, little oblique anteriorly, more so posteriorly; $SC^{1,2}$ stalked, their stalk anastomosing with *C*, SC^2 connected by a short bar with $SC^{3,4}$, M^1 from near end of cell; a slight fovea; ground-colour white, irrorated almost throughout with bright brown; cell-mark blackish, confused with the median shade; lines darker; a thick, ill-defined subbasal; antemedian double, oblique inward and with a deep subcostal indentation, the outer line (the true antemedian) the less thick; median oblique from costal to cell-mark, deeply outbent round it, angled inward at base of M^2, weak and diffuse posteriorly; postmedian deeply outbent at $R^{1,2}$, oblique inward to base of M^1, again oblique inward behind SM^2; the shade outside it indistinct except at hind margin; subterminal consisting of slightly disconnected lunules, filled in with dark spots proximally, especially in cellules 5, 4 and 2; an oblique dark terminal mark in cellule 6; termen with interneural blackish dots; (fringe damaged).—*Hind-wing* with termen

rounded and subcrenulate; cell-spot distinct; median line slightly sinuous, fairly distinct from *SC* to abdominal margin; postmedian very faintly crenulate, almost right-angled just behind R^1 (the angle slightly rounded off); rather oblique outward from behind base of M^1 to tornus; markings beyond much as on fore-wing, the line outside the postmedian not strengthened at hind margin.

Underside more evenly irrorated, looking almost uniform brown, slightly duller and more chocolate-tinged than above; cell-spots fairly large, strong; median shades indicated, especially on fore-wing costally; a postmedian line, accentuated on the veins, on fore-wing oblique outward from costa to SC^5, then about vertical, curving very gently so as to become, from about R^2, nearly parallel with termen; on hind-wing approximately parallel with termen, but rather more excurved between SC^5 and R^3, very faintly incurved anteriorly; terminal spots very weak on fore-wing, rather less so on hind-wing.

Probably nearest to *proëmia* Prout (Nov. Zool., xxiv. 435), described from ♂♂ only, but subsequently proved to have a strongly pectinate ♀. That species also has the rather closely-scaled palpus and a very slight (not absent) tongue and the two probably represent an endemic development (genus ?). *C. euplates* is, however, further removed in facies from typical *Cleora* through its considerably broader wings, is more brightly coloured than *proëmia*, with slightly different venation and various other distinctions.

26. **Boarmia coryphocycla,** sp. n. (Fig. 25.)

♂, 31 mm. Face rounded, not prominent, scarcely rough-scaled. Palpus scarcely over 1, second joint with appressed scales, third joint small. Tongue perhaps wanting, at most very slight. Antenna shortish, bipectinate with very long branches. Hind tibia not dilated. Head and body concolorous with wings.

Fore-wing with fovea not very strong; $SC^{1,2}$ coincident, anastomosing very shortly with C; light slaty grey, irrorated with black, and with a copious sprinkling of glistening silvery scales; lines black, marked with minute dashes on the veins; antemedian double, angled in cell; median less slender than the others, thickened at costa, deeply excurved round the cell-dot, then oblique inward and sinuous; postmedian less sharply curved anteriorly, then very slightly more oblique than termen; subterminal indicated by a dark proximal shade and by a very characteristic roundish ochraceous-buff spot between SC^5 and R^1; terminal line forming deep black

interneural dots; fringe chequered.—*Hind-wing* with termen only feebly crenulate; antemedian lines wanting; the rest nearly as on fore-wing, the median proximal to the cell-dash, less excurved, the postmedian with a duplicating shade distally which is only faintly suggested on fore-wing.

Underside grey, more uniform, with blackish cell-marks and median and postmedian lines, the postmedian of the fore-wing not excurved anteriorly; fringes weakly chequered.

27. **Boarmia idiochroa,** sp. n. (Fig. 28.)

♂, 39 mm. Face and antenna much as in the preceding species. Palpus 1⅓, 2nd joint rather slender, but densely scaled beneath. 3rd joint short. Tongue slender. Hind tibia not dilated. Head and body concolorous with wings; palpus darkened in distal part.

Fore-wing with termen almost smooth, gently curved; fovea rudimentary; $SC^{1,2}$ coincident, free; whitish, irrorated and suffused almost throughout with deep reddish fawn, spots of the ground-colour appearing chiefly near the hind margin and on veins R^3, M^1, M^2 and SM^2; cell-spot black, slightly elongate; lines dark brown; antemedian somewhat curved, somewhat thickened at costa, M and SM^2, very oblique inward from SM^2 to hind margin; median thick and oblique outward at costa, straightish outside cell-spot, slightly incurved and a little interrupted behind; postmedian lunulate-dentate, the lunules small (except the one between M^2 and SM^2), the teeth outward on the veins short but thick; subterminal lunulate-dentate, the first two lunules, the two radial ones and those from R^3 to hind margin filled in proximally with dark brown spots; termen with interneural dots or dashes; fringe pale, somewhat chequered. *Hind-wing* with termen very faintly waved; rather more of the white ground-colour showing; cell-spot large; antemedian obsolete; median proximal to cell-spot; outer markings nearly as on fore-wing.

Both wings beneath paler, especially the fore-wing posteriorly and the hind-wings; cell-spots and median and postmedian lines present, except on pale posterior part of fore-wing; both wings with a costal spot at origin of postmedian.

♀ much larger (56 mm.), paler.

28. **Psilocerea kenricki,** sp. n. (Fig. 22.)

♂, 40 mm. Face pale reddish ochreous, a few black scales on side, the looser hairs at its lower extremity mixed with black. Palpus rather less than 1½; outerside sprinkled with black; the small terminal joint black. Vertex whitish ochreous; occiput reddish ochreous. Antennal shaft spotted with blackish; pectina-

tions about 6. Thorax and abdomen pale ochreous, the abdomen above more fleshy, both with stronger reddish admixture anteriorly on upperside. Legs speckled and with black spots at ends of joints; hind tibia not dilated.

Fore-wing with apex not acute; $SC^{1,2}$ shortly stalked, SC^1 anastomosing at a point with C; R^1 about connate with SC^{3-5}; M^1 well separate from R^3; pale ochreous, the proximal area and the proximal part of distal area (broadening to apex) bright reddish brown; some scattered black irroration; fovea pale, with a black spot proximally; cell-dot rather large, deep black; lines black; antemedian at 5 mm., slightly dentate outward on M and on SM^2; median area with M and its branches darkened, the irroration here strigiform; an incomplete cloudy median well beyond the cell-dot; postmedian excurved anteriorly, incurved posteriorly; two subterminal black spots between R^3 and M^2; fringe somewhat reddened.—*Hind-wing* with termen very bluntly bent at R^3; proximal area and apical region not reddened, the band outside the postmedian weak; antemedian and median wanting; cell-dot small; postmedian little beyond; subterminal spots in all the cellules; fringe somewhat reddened.

Underside similar, the reddish shades less strong, the antemedian of the fore-wing and the postmedian of the hind-wing rather more curved; median shade of fore-wing obsolescent; hind-wing with a slender costal commencement of a curved antemedian.

29. **Psilocerea scardamycles,** sp. n.

♂, 42 mm.; ♀, 46 mm. Head very pale brown. Palpus about 1¼; slightly greyer on outer side. Antennal shaft white; pectinations in ♂ long; ♀ antenna subdentate in proximal part, minutely ciliate. Thorax and abdomen concolorous with wings. Fore-leg grey, the other legs paler, with some dark irroration; hind tibia of ♂ with moderate, pale hair-pencil.

Fore-wing in ♂ with termen slightly rounded-prominent in anterior part, in ♀ slightly concave between the acute apex and R^3, consequently with a blunt angle at R^3; $SC^{1,2}$ as in the preceding, R^1 stalked (especially in the ♀), M^1 closely approximated at origin to R^3; warm brown, slightly variable in tone, irrorated, and in places clouded, with dark grey; antemedian line obsolete; cell-dot very small but slightly raised, white, in its proximal part strongly mixed with black; postmedian line deeper and rather brighter than the ground-colour, edged distally with very pale yellow, oblique from SC^5 near apex to hind margin at nearly two-thirds, its costal extremity lost in some black-grey suffusion; fringe slightly darkened.—*Hind-wing* with termen rounded anteriorly, straight

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or faintly subconcave posteriorly, hence appearing a little gibbous in middle; very slightly paler than fore-wing (considerably paler at costa); cell-dot minute, grey; line continued; fringe as on fore-wing.

Underside rather less bright, the irroration rather strong but rather sparse; both wings with minute black cell-dot; line obsolete or nearly so; fore-wing with a blackish spot at its point of origin, some hoary scaling between this and apex; fringes as above.

Explanation of Plate XXXVI.

Fig. 1. *Leptocolpia oxygonia* sp. n. ♂.
„ 2. *Hypocoela spodozona* sp. n. ♂.
„ 3. *Hypocoela drepana* sp. n. ♂.
„ 4. *Blechroneromia mianta* sp. n. ♂.
„ 5. *Blechroneromia eluta* sp. n. ♂.
„ 6. *Blechroneromia perileuca* sp. n. ♂.
„ 7. *Blechroneromia anthosyne* sp. n. ♀.
„ 8. *Archichlora chariessa* sp. n. ♂.
„ 9. *Ptochophyle orthogramma* sp. n. ♀.
„ 10. *Ptochophyle anthocroca* sp. n. ♂.
„ 11. *Ptochophyle volutisignata* sp. n. ♀.
„ 12. *Ptochophyle kenricki* sp. n. ♂.
„ 13. *Hypochrosis azalea* sp. n. ♂.
„ 14. *Xanthodura* (?) *hypocrypta* sp. n. ♀.
„ 15. *Ptochophyle peristoecha* sp. n. ♂.
„ 16. *Ptochophyle zaphleges* sp. n. ♂.
„ 17. *Ptochophyle gnamptoloma* sp. n. ♀.
„ 18. *Ptochophyle polyniphes* sp. n. ♂.
„ 19. *Hypochrosis teleutaea* sp. n. ♂.
„ 20. *Hypochrosis hypostigmica* sp. n. ♂.
„ 21. *Ectropis annumerata* sp. n. ♀.
„ 22. *Psilocerea kenricki* sp. n. ♂.
„ 23. *Anisodes metamorpha* sp. n. ♂.
„ 24. *Luxiaria pratti* sp. n. ♂.
„ 25. *Boarmia coryphocycla* sp. n. ♂.
„ 26. *Cleora euplates* sp. n. ♀.
„ 27. *Cleora emphona* sp. n. ♀.
„ 28. *Boarmia idiochroa* sp. n. ♂.

XI. *On the Scent-sacks in the genus* Rhodogastria. By G. T. Bethune-Baker, F.L.S., F.Z.S.

[Read May 6th, 1925.]

Plates XXXVII–XLII.

Lepidopterists who have studied the *Arctiinae* will remember the strong odour present in the genus *Rhodogastria*: when the specimens are fresh the scent is very strong indeed, and it remains so for several years, so much so that when I have had a drawer out for a little time I have, more than once, been asked, "What is this unpleasant smell?" I have several times looked for its cause, both in the abdomen and at the base of the wings, for the slight thoracic exudations do not seem to be sufficient to account for the strong scent, but my investigations were fruitless.

When, however, before the war, I was examining the genitalia of various genera in this group, I found in *Rhodogastria* two sacks, one on each of the harpagines, and it seemed at once to solve this mystery of the peculiar odour—these are the scent-sacks; but I could find no record of such a thing attached to the genitalia. These sacks are situated on the outside of the harpagines, in which there is a deep depression wherein the sacks rest more or less in a telescopic fashion: the upper layer of chitin appears to be very greatly reduced in thickness in the harpago, and thus forms a hollow in which the sack rests folded up: at the back of this, on the inner side of the harpago, is a large strong hook which, for reasons I shall give later on, is doubtless the mechanism whereby the scent-sack is sprung forth out of its resting place. In some species these organs are very long, in others they are quite short, whilst in others they appear to be absent; that is to say, I have been unable to dissect them out. I have little doubt that they are there, for the depression and the thinning of the chitin is there and also the hooks, but the sacks have disappeared: the reason being that they are in some species so fine and probably small that the least application of caustic potash or other reducing agent seems to entirely dissolve them.

Lord Rothschild, who has kindly examined this, considers it to be a subspecies of *affinis* from South Africa.

The genitalia are very different from its near allies: the shape of the harpagines is very different, as will be seen from the figure; they are thickly furnished with long fine hairs, densely so along the line of the hooks, which are large and strong and are provided with longish straight teeth on their convex margin; the scent-sacks have unfortunately eluded me, but the usual thinning of the chitin is visible.

Rhodogastria vitripennis Boisd. Plate XL. fig. 10 ♂, 10a ♀.

The hooks are large and highly curved, and in the region of the curve are furnished with short, sharp, strong teeth; the scent-sacks have again eluded my technique, probably being very delicate and easily detached, so that they have disappeared in the clearing process, but their nesting places are easily seen in the chitin below the hooks; the fringe of hairs on the clasp that invariably accompanies them is very plainly shown in the plate around the depression wherein the scent-sack ordinarily rests. At fig. 10a I have shown the bursa copulatrix of the female; the internal apex is seen to be provided with bundles of very formidable spike-like sclerites, no doubt of an excitatory nature, whilst the proximal end is rather of a complicated structure.

Rhodogastria nigropunctata B-B. Plate XL. fig. 11.

The hooks are long and highly curved and have a number of very small, sharp teeth. This is another case where the scent-sack has eluded both my friends and myself; at the same time the depression in the chitin is clearly visible in the plate, as also the fringe on the lower lip of this depression.

Rhodogastria crokeri Macl. Plate XLI. fig. 12.

The hooks are large, highly curved, and provided with a series of short, sharp teeth; the scent-sacks are very long and closely studded with setae that are rather constricted centrally and arise from rather more or less of a tubercle formation than from mammae; the extremity has a most copious fringe of the longest filaments of any species I have examined, which are of a crenulate formation.

Rhodogastria astreas Drury. Plate XLI. fig. 13.

The hooks are largish, highly curved with a series of short, sharp spines; the scent-sack is shortish, though the one figured is not

extended to its full length: it is well provided with setae arising from small mammae-like protuberances: the extremity has a tuft of long rather fine filaments.

Rhodogastria baueri Moesch. Plate XLI. fig. 14.

The hooks are deeply but broadly curved and with a series of short, sharp teeth-like projections: the scent-sack is long, well provided with mammae-like protuberances from which arise large tubular setae tapering distally: the extremity terminating in a fringed rosette rather like a chrysanthemum. This does not come out well in the figure.

Rhodogastria albivitrea Hamps. Plate XLII. fig. 15.

The hooks are small, well curved and stoutish: the scent-sack has again disappeared, although its place is clearly indicated as in some of the previous species.

Rhodogastria vitrea Plötz. Plate XLII. fig. 16.

The hooks are fairly large and without dentations: the scent-sack is also of large dimensions, that shown in the figure is not by any means extended to its full length: the ridges are closely studded with small mammae-like protuberances emitting longish setae which are larger at the base and taper narrowly distally; the extremity is copiously furnished with long, ribbon-like filaments. The scent-sack is well figured in the other clasp at rest, nested up in its depression.

Rhodogastria eugenia Fab. Plate XLII. fig. 17.

This species is perhaps more generally known as *fraterna* Moore; its hooks are long and highly curved, with short, strong bristles, not visible in the figure: the scent-sack is long with short mammae-like protuberances, emitting moderately long setae, slightly globular at the base and tapering narrower distally: the extremity is furnished with a long tuft of irregular-shaped filaments: the scent-sack at rest is well seen in the other clasp on the plate.

Rhodogastria invidua sp. n.

♂. Head, face and thorax dove-brown: a dark spot in the centre of the head, and on each of the cup-like antennal bases: antennae dark grey: two spots on the collar, one on the patagia, two on the dorsum: abdomen pale brownish-pink above, tawny cream below, with a row of lateral black spots: legs, cell, brown above, pink below and laterally with the tarsi developing into pink. Wings,

upperside, uniform pale dove-brown with the median and post-median areas very slightly diaphanous; secondaries subdiaphanous, of a brownish-pale cream-colour.

Expanse 48 mm.

Hab. Sierra Leone.

Type in my collection.

Lord Rothschild has kindly examined this specimen as well as others, and says it is intermediate between *mauritia* and *vidua*.

Explanation of Plates XXXVII–XLII.

PLATE XXXVII.

Fig. 1. Scent-sacks and genitalia of *Rhodogastria lupia*. × 12 diameters.

2. Scent-sacks and genitalia of *Rhodogastria rubripes*. × 12.

3. Scent-sacks and genitalia of *Rhodogastria caudipennis*. × 8.

In fig. 1 the genitalia are cut and laid open, figs. 2 and 3 are profile "in situ."

PLATE XXXVIII.

Fig. 4. Scent-sacks and genitalia of *Rhodogastria omissa*. × 10.

5. Scent-sacks and genitalia of *Rhodogastria arthus bertrand*. × 8.

6. Genitalia (scent-sacks not visible) of *Rhodogastria luteibarba*. × 14.

In fig. 4 the genitalia are cut and laid open, figs. 5 and 6 are profile "in situ."

PLATE XXXIX.

Fig. 7. Small scent-sacks with brushes and genitalia of *Rhodogastria timiolis*. × 12.

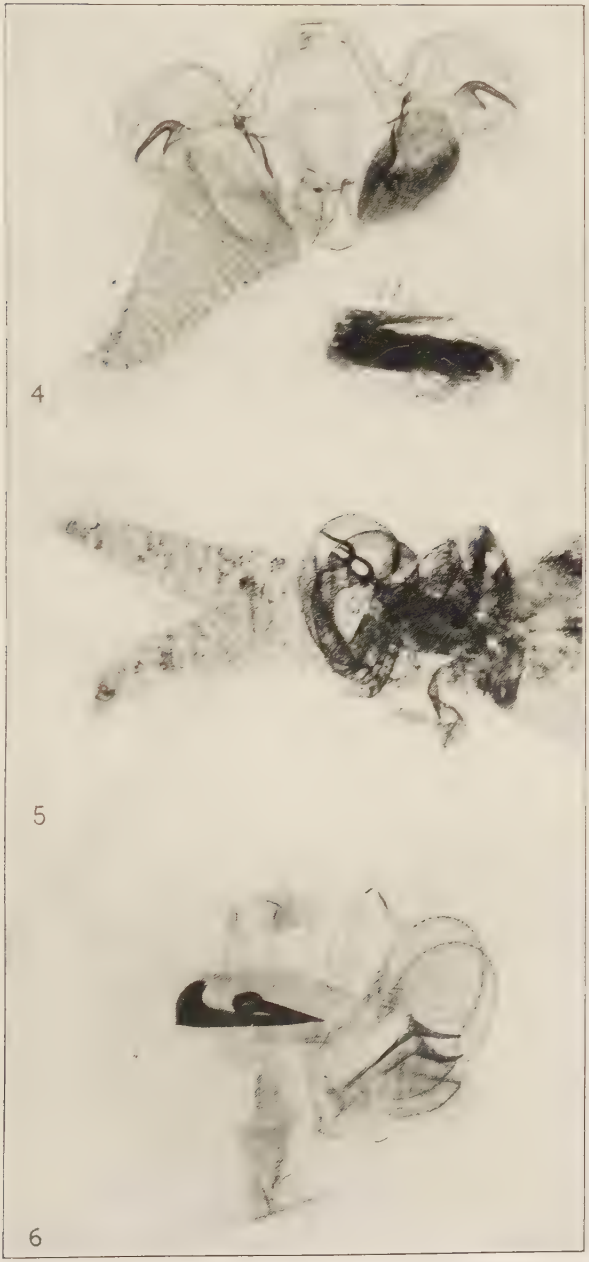
8. Scent-sacks with brushes and genitalia of *Rhodogastria mauritia*. × 8.

9. Scent-sacks with brushes and genitalia of *Rhodogastria affinis pallens*. × 14.

All these genitalia are cut and laid out open.

Vaus & Crampton, Ltd.

GENITALIA OF RHODOGASTRIA.



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GENITALIA OF RHODOGASTRIA.

Vaus & Crampton, Ltd.

GENITALIA OF RHODOGASTRIA.

GENITALIA OF RHODOGASTRIA

15
16
17

PLATE XL.

FIG. 10. Genitalia (scent-sacks not visible) of *Rhodogastria vitripennis.* × 12.

10*a*. Reproductive organs ♀ of *Rhodogastria vitripennis.* × 10.

11. Genitalia (scent-sacks not visible) of *Rhodogastria nigropunctata.* × 12.

In fig. 10 the genitalia are cut and laid out open, fig. 11 is profile "in situ."

PLATE XLI.

FIG. 12. Scent-sacks and genitalia of *Rhodogastria crokeri.* × 7.

13. „ „ „ „ *astreas.* × 12.

14. „ „ „ „ *baueri.* × 8.

In fig. 12 the organs are profile "in situ," in figs. 13 and 14 they are cut and laid open.

PLATE XLII.

FIG. 15. Genitalia (scent-sacks not visible) of *Rhodogastria albivitrea.* × 14.

16. Scent-sacks and genitalia of *Rhodogastria vitrea.* × 8.

17. „ „ „ „ *eugenia.* × 9.

In all these figures the organs have been cut and laid out open.

N.B. The smaller organ sometimes loose from the other or ans is the aedoeagus.

XII. *On the Wing-coupling Apparatus of the* Hepialidae.

By Alfred Philpott, Assistant Entomologist, Cawthron Institute, Nelson, New Zealand.

[Read May 6th, 1925.]

(With Five Text-figures.)

The Hepialidae form an isolated group of the lower Lepidoptera. It has been the custom of late years to place the family in the Sub-order Lepidoptera Jugata, this group being divided again into the super-families Hepialoidea and Micropterygoidea. One of the chief distinctions between the Jugata and the Frenata is the possession by the former of a small lobe (the jugum) situated at the dorsal base of the fore-wing. Comstock (1) states that "In . . . the Hepialidae, the posterior lobe of the fore-wing is a slender, finger-like organ, which is stiffened by a branch of the third anal vein, and which projects beneath the costal margin of the hind-wing. As the greater part of the inner margin of the fore-wing overlaps the hind-wing, the hind-wing is held between the two." Meyrick (3) defines the Micropterygina (= Lepidoptera Jugata) as follows :—"Fore-wings with an oblique membranous dorsal process (jugum) near base, forming with the dorsal margin a notch or sinus which receives the costa of the hind-wings." This definition is repeated, in substance, in his revision of the Micropterygidae (*sens. lat.* in the Genera Insectorum (4)). Macgillivray (2) says, "The moths of the Sub-order Jugatae have a finger-like lobe on the caudal margin of the meso-wing which fits on the ventral side of the meta-wing, fitting thumb and finger-like around the costal margin of the meta-wing. This finger-like lobe is known as the jugum. It is stiffened by one of the branches of the third anal vein. In museum specimens the jugum frequently rests upon the dorsal surface of the meta-wing." The writer (5), by the examination of living and freshly-killed material, was able to show that in the Micropterygoidea the jugum functioned by resting on the upper surface of the hind-wing, thus not forming with the more distad portion of the dorsum a finger-and-thumb grip on the costa of the hind-wing, but

acting precisely as does the jugum in certain families of the Trichoptera. Tillyard (6), while accepting the current definition of the Hepialoidea, as far as the coupling-apparatus is concerned, points out that in set specimens the jugum is frequently to be found resting on the dorsal surface of the hind-wing, and also that in *Pielus* the structure cannot be made to pass beneath the wing and must therefore function by resting on the upper surface. In view of these facts he modifies the definition of the Hepialidae so as to read, " jugal lobe elongated and narrow, usually passing beneath the hind-wing."

In dried specimens of the Hepialidae the lateral margins of the jugum tend to fold in, giving the structure the appearance of a thin pointed spine-like organ; this has been frequently responsible for incorrect figures and descriptions. As a matter of fact the organ is simply an unmodified portion of the wing-membrane, not more nor less chitinised than the rest, rather concave, and only slightly tapering to a bluntly rounded apex. In *Hectomanes*, however, the apex is moderately pointed.

Both Macgillivray (2) and Comstock (1) state that the jugum is " stiffened by one of the branches of the third anal vein." I have been unable to detect any vein entering the organ, nor does Macgillivray himself show such a vein in his figure of the venation of *Sthenopis thule*. Probably the incurved outer margin of the jugum has been mistaken for a vein. I give figures of the jugum in several of the genera, these having been drawn, except where otherwise stated, with the aid of the camera lucida after maceration of the material in a ten per cent. solution of caustic potash. A study of these figures shows that, beyond proportionate size, there is very little difference in the organ in the various genera. In *Leto staceyi* Scott the jugum is very small in proportion to the size of the wing, and probably is of little use in holding the wings together. It would, however, when the wings are extended for flight, have a slight hold on the costa of the hind-wing above, a little distad of the humeral vein, that is, if capable of being drawn into such a position. It may be that it has become functionless and permanently occupies the " rest " position under the fore-wing; in the few set specimens which I have been able to examine it was so placed. The wings in *Leto* are narrower, proportionately, than in any other genus of the family. They are also placed further apart

on the thorax. The basal three-fourths of the costa of the hind-wing is practically straight, the humeral area being very slightly arched. The base of the fore-wing is exceptionally narrow, and these factors, taken together, result in the presence of a large open space between the bases of the extended wings, a position parallelled in *Sabatinca* (Micropterygidae) but only present, if at all, in a very slight degree in any other Hepialid genus. It will be seen, therefore, that unless the wings in *Leto* overlap, during flight, to a very unusual extent, an efficient amplexiform method of wing-coupling is not possible; neither can the comparatively minute jugum be of much service. Is it not probable that the flight of *Leto* consists chiefly of gliding or "planeing," and that flapping or beating takes little part in it? In the former case the coupling of the wings would be of much less importance.

It should also be noted that, in the Hepialidae, the costal margin of the humeral area in the hind-wing is clothed with long soft hair, quite undifferentiated from that of the more distal portion. There is no trace of any rudimentary or vestigial frenular hairs such as occur in the Micropterygidae, nor is the series of costal bristles which takes the place of the true frenulum in that family present in the Hepialidae.

As remarked by both Tillyard (6) and Macgillivray (2), the jugum is frequently found in set moths to lie above instead of beneath the hind-wing. In order to ascertain in about what proportion this occurred I examined a series of 19 examples of various species of *Charagia*. Ten specimens were found to have the jugum resting on the upper surface of the hind-wing; in 3 it passed beneath the wing, and in 6 it was above on one side and beneath on the other. That is to say, out of 38 instances the jugum had assumed a resting position above the hind-wing in 26 cases, or slightly over 68 per cent., while in the remaining 12, or rather less than 32 per cent., it was found in the supposedly normal position. This is quite contrary to what would be expected if the organ really did function beneath the hind-wing. The jugum, in that case, lying a little lower than the general plane of the wing, would be closely appressed to the surface of the setting board when the wing was drawn forward to the usual position; the costa of the hind-wing on being also drawn forward would be much more likely to slip above the jugum than beneath

it. In many instances where the jugum was found to rest beneath the hind-wing it was seen to point more or less obliquely away from the surface; in only a few cases was it observed to lie closely against the wing. It seems probable that in these latter instances the specimen had been placed, in setting, rather deeper than usual in the

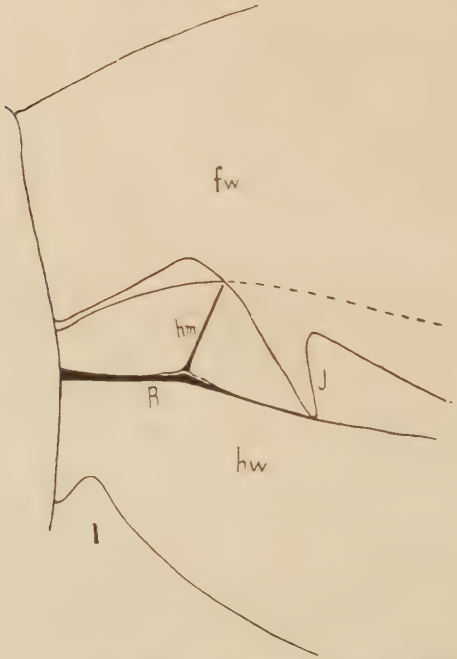

Fig. 1.—*Porina jocosa* Meyr. Bases of fore-wing and hind-wing, viewed from above; set specimen. *fw*, fore-wing; *hw*, hind-wing; *hm*, humeral vein; *j*, jugum; *R*, radius.

groove of the board, and the tracing papers, securing it in that position, had pressed the jugum closely against the wing-surface above it.

A series of 17 specimens of *Porina jocosa* Meyr. was then examined. Out of the 24 instances there were 22, or 64·7 per cent., in which the jugum rested on the upper surface of the hind-wing, and 12, or 35·3 per cent., in which it was recurved beneath the fore-wing; that is to

say, it did not in any single instance act as a finger-and-thumb fastening. Where the jugum was found to lie above the hind-wing its apex frequently rested against the strongly convex basal portion of the radius.

Consideration of the above phenomena led to the conclusion that the idea of the finger-and-thumb coupling apparatus in the Hepialidae was probably a mistaken one, and the next step was to examine specimens of the family immediately after death, so as to ascertain the position of the jugum before setting and drying of the specimen could have interfered with the natural position of the parts. Some specimens of *Porina cervinata* Walk., or a closely allied species, were obtained, and having been killed were examined immediately. From one specimen the fore-wings were snipped off at their junction with the thorax; the jugum was found to occupy a recurved position beneath the wing, being quite out of sight from above, just as in *Sabatinca*. Other specimens were then pinned on a setting board: when the fore-wings of these were moved forward the jugum was seen to be drawn from its folded position beneath the wing to one caudad of the dorsum. It did not, however, rise to the plane of the wing but assumed an obliquely downward direction. In this position it certainly forms a sinus capable of receiving the costa of the hind-wing, but it must be noted that it could only oppose its edge, not its flat surface, to the surface of the hind-wing and would thus have a very inefficient grip, particularly as, owing to its oblique direction, only its basal part could take part in this function. The more the wing is forced forward the more the jugum rises towards the wing-plane. When the hind-wing is moved forward the costa almost invariably slips beneath the jugum, and the pressure from beneath causes the organ to flatten out more and press tightly on the costal area near the humeral vein, its apex being close to the radius.

Mr. G. V. Hudson, of Wellington, very kindly undertook to send me a living or freshly-killed example of *Charagia virescens* Dbld., that fine species not occurring in Nelson. In fulfilment of his promise I duly received the moth. It was dead on arrival, but as Mr. Hudson had taken the precaution to place a piece of damp sponge in the box the specimen was in a perfectly fresh and flexible condition. On being pinned on a setting-board it was observed that the jugum was folded beneath the fore-wing in precisely

the same manner as occurs in the Micropterygidae (Lepidoptera) and the Rhyacophilidae (Trichoptera). On the wing being moved forward the jugum unfolded, coming into view when the wing was at an angle of about 45 degrees to the thorax. When expanded more fully a check was experienced at a certain point, and this could be taken to indicate the normal fully opened position. In this position the line of the costa is at a little more than a

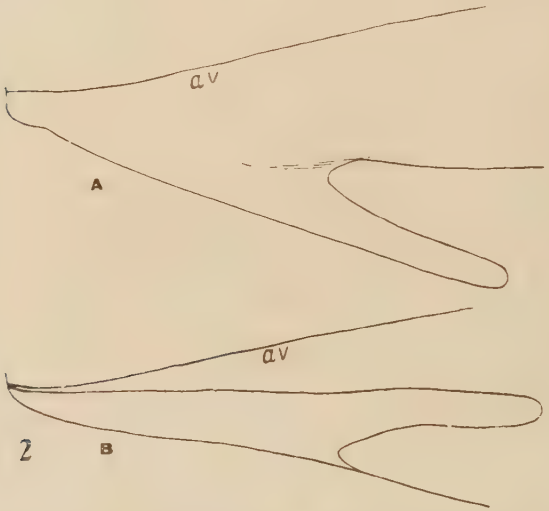

Fig. 2.—*Charagia virescens* Dbld. Freshly-killed specimen. *A*, jugum flattened out under cover slip, as it appears when resting above hind-wing. *B*, jugum folded beneath fore-wing, as it appears when the wing is not expanded for flight. *av*, anal vein.

right angle to the thorax. In *Charagia*, as in most other Lepidoptera, the anal area of the fore-wing is convex, the dorsal margin being consequently bent somewhat downwards. When the fully extended fore-wing is held clear of the hind-wing, and does not rest on any surface, this downward curve is sufficient to cause the dorsum to rest slightly below the plane of the jugum. With the wing in this position it was found almost impossible to make the hind-wing engage in the sinus of the jugum and dorsum. To make it do so it was necessary to bend the hind-wing up over the jugum and then depress it, so as to make it

slip beneath the dorsum, a very unlikely set of movements under natural conditions. It may be here noted that in the only example of *Sthenopis*, a specimen of *S. argenteomaculatus* Harris, available for examination, the jugum lay beneath the hind-wings. But at that point the hind-wings were prominently "buckled," as if they had been forced, in setting out, into what was considered to be the correct position.

But the probability is that the fore-wings and hind-wings are opened simultaneously, as is certainly the case in the Lepidoptera Frenata. In such a case it is conceivable that the jugum, when being drawn out from beneath the fore-wing, might pass beneath the costa of the hind-wing, but in point of fact this did not occur in any of the freshly-killed specimens examined.

There has also to be considered a striking fact in connection with the colour of the jugum. Where there is any difference between the colour of the upper and lower surfaces of the hind-wing, it will be found that the colour of the jugum is the same as that of the upper surface, whereas if the normal position of the structure were beneath the wing it would be expected that there would be agreement in colour with that surface. Usually, in the Hepialidae, the colour of the upper and lower surfaces of the hind-wings is practically the same, but there is a fair number of instances in which there is a marked difference. Only the colour of the humeral region need concern us here, as that is the area with which the jugum must come into contact, whether above or below the wing. In the female of *Charagia ramsayi* Scott, the humeral area above is dull pinkish; on the underside it is dull green. In the same sex of *C. splendens* Scott, the upperside is bright pink, while the underside is again dull green. In the New Zealand *C. virescens* Dbld. the female has the humeral upper surface dull pink, while the male has the same area dull whitish, sometimes slightly pink or bluish tinged: in both sexes the under surface is more or less green. The genus *Porina* shows little difference in most of the species, but *P. characterifera* Walk. is an exception to the rule. Here, in the male, the upper humeral surface is dark fuscous, while the lower side is ochreous. In all these instances the jugal hair agrees with the colour on the *upper* surface.

The most convincing evidence, however, of the superior

position of the jugum in relation to the hind-wing during flight, came from some examples of *Porina* which had been killed in the ordinary cyanide bottle. In order to avoid the displacement of the parts through struggling, those first examined had been killed while held in the

Fig. 3.—*Pielus hyalinatus* H.S. Jugum, from beneath.

fingers by having the head removed with a scalpel. When killed by cyanide fumes, the victims frequently die with their wings raised up above the back in the same manner as those of a butterfly when at rest. In such cases the wings are expanded in much the same relative position as in flight. On specimens which had been killed in this

Fig. 4.—*Trictena labyrinthica* Don. Jugum, from beneath.

manner being examined, it was found that the jugum did not show beneath. The wings were then carefully depressed to a horizontal position, when the structure was seen to be lying on the upper surface of the hind-wing, except in some instances, in which it was folded beneath the fore-wing.

Summary and Conclusions.

From a consideration of the above facts and indications, from the ease with which the jugum usually passes above the hind-wing, from the practical impossibility of the hind-

wing in some species being made to pass above the jugum, from the indications not infrequently supplied by the colouring of the parts and from the examination of unset and freshly-killed specimens, it is concluded that the wing-coupling apparatus of the Hepialidae functions in exactly the same manner as that of the rest of the Homoneura, that is, that the jugal lobe is folded beneath the fore-wing when the insect is at rest, and, with the opening of the wings for flight, assumes a position on the *upper* surface of the hind-wing, not *beneath* it as was formerly supposed.

This conclusion carries with it the abandonment of "Lepidoptera Jugata" as a systematic term. If it is

Fig. 5.—*Hectomanes simulans* Walk. Jugum, from beneath.

still thought desirable to have a name based on the characters of the wing-coupling then "Lepidoptera Fibulata" might be used, but, of course, this would apply to the whole of the Homoneura, not to the Hepialidae alone. But it seems the better plan to discard the names having reference to the method of wing-coupling, and to use instead those based on the venation, *i.e.* Heteroneura and Homoneura, the two distinct groups of the latter falling under the superfamilies Micropterygoidea and Hepialoidea, the former of which includes the families Micropterygidae, Eriocraniidae and Mnesarchaeidae, while the latter comprises the Hepialidae, Prototheoridae, Palaeosetidae and Anamosetidae.

In conclusion, my sincere thanks are due to Mr. G. V. Hudson, of Wellington, N.Z., and Dr. A. Jefferis Turner, of Brisbane, Queensland, for material received; also to Dr. R. J. Tillyard for his interest in the investigation.

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August 7, 1925.

XIII. *New Species of* Staphylinidae *from India.* By Malcolm Cameron, M.B., R.N., F.E.S.

[Read June 3rd, 1925.]

Part II.

[Continued from Trans. Ent. Soc. Lond. 1924, p. 198.]

Staphylininae.

Mitomorphus purpurescens n. sp.

Shining, head black with aeneous reflex, thorax pitchy red; elytra black with purplish bronze reflex; abdomen brown, darker medially with greenish reflex, the last two segments black. Antennae ferruginous. Legs reddish-testaceous. Length 5·5 mm.

A narrower species than *M. obsoletus* Fauv., the head and elytra similarly coloured, the puncturation of the thorax much finer, the elytra shorter, more convex and almost impunctate. Head oblong, as wide as but shorter than the thorax, the posterior angles rounded, coarctate with the base; frontal furrows short, parallel, the lateral obsolete, punctiform, puncturation very fine and very sparing even on the sides. Antennae with the 3rd joint shorter than 2nd, 4th to 10th transverse, the penultimate joints fully twice as broad as long. Thorax much longer than broad, slightly narrowed and sinuate behind with a row of 7 or 8 very fine punctures on either side of the middle, laterally very finely and irregularly punctured, behind the anterior angles with 2 or 3 larger punctures, the margins all less pitchy and more ferruginous than the disc. Elytra broader but scarcely longer than the thorax, convex, scarcely longer than broad, practically impunctate, finely and very sparingly pubescent. Abdomen very finely and very sparingly punctured and pubescent.

Mussorie District; Arni Gad and Kaligad. At the edges of streams under dead leaves, etc.

Mitomorphus cribriceps n. sp.

Black, head opaque, densely, rather finely punctured; thorax shining; elytra bronze-black, shining. Antennae ferruginous; femora pale testaceous, tibiae and tarsi reddish-testaceous. Length 7 mm.

Remarkable by the densely punctured and opaque head, the rest of the insect shining. Head very similar in build to *M. obsoletus* Fauv., but the thorax is narrower and (viewed from above) the sides are practically parallel, and the elytra much shorter. Head as wide as the thorax, oblong-ovate, the posterior angles coarctate with the base; median furrows rather long, sinuate, narrow, ending behind in a setiferous puncture, the space between smooth and shining, the external very fine, oblique; the whole surface opaque and densely punctured, the sides with a few larger obsolete setiferous punctures. Antennae with 3rd joint a little shorter than 2nd, 4th to 10th transverse gradually increasing in width. Thorax much longer than broad, shining, viewed from above with the sides practically parallel, on either side of the disc with a row of 7 moderate punctures, the first of them on, the 2nd some distance behind the anterior border, the rest equidistant from each other, externally with a row of 4 others and a further single puncture some distance behind the anterior angle and the extreme margin with a row of punctures; antero-externally an irregular space not extending to the sides or anterior angle or internally beyond the row of 4 punctures is finely and closely punctured. Scutellum coriaceous, bipunctate. Elytra wider but shorter than the thorax, a little longer than broad, the disc with three rows of fine setiferous punctures, 7 sutural, 7 humeral and 4 intermediate, the 4th of this latter series on a level with the 4th of the sutural series; reflexed margin with a row of 7 similar punctures, otherwise impunctate and without ground-sculpture. Abdomen finely and sparingly punctured and with sparing greyish pubescence, the bases of the segments strongly, the rest slightly, coriaceous.

Mohan Rau, Siwaliks. A single specimen in stream débris.

Leptacinus notabilis n. sp.

Narrow, elongate, pitchy-black, the elytra fusco-testaceous. Abdomen black, shining, the apex ferruginous, the 7th segment strongly coriaceous and more opaque. Antennae with the first three joints testaceous, the following blackish. Legs testaceous. Length 4·5 mm.

Of the average size and the slender build of *L. filum* Kr., but the head is shorter, oval and a little widened behind the eyes, the antennae darker and the 7th abdominal segment strongly coriaceous. Head black, shining, oval, slightly widened behind the eyes, wider than the thorax, frontal furrows parallel, well marked, lateral very short; disc and front broadly impunctate, at the sides with a few

moderate punctures, temples finely and sparingly punctured. Antennae with 3rd joint shorter than 2nd. 4th to 10th transverse, gradually increasing in width. Thorax long and narrow, gradually contracted behind, disc on either side with 10 or 11 punctures, at the sides with a curved row of 6 or 7 and 1 or 2 behind the anterior angles. Elytra as long as, but broader than the thorax, longer than broad, very finely and very sparingly punctured. Abdomen black, shining, very finely, sparingly punctured and with sparing yellow pubescence, very finely and obsoletely transversely strigose except the 7th segment which is strongly coriaceous and less shining than the others.

Chakrata District: Sijla Gad, 5000 feet above sea.

Xantholinus niger n. sp.

Entirely black, shining. Thorax with a dorsal row on either side of 7 rather large punctures. Elytra moderately finely, rather superficially subseriately punctured. Antennae with the 1st joint black, the rest dark brown. Legs dark brown. Length 11 mm.

In build very similar to *X. metallicus* Fauv., but larger and without trace of metallic reflex, the dorsal row of thoracic punctures larger, the elytra more finely, less closely and subseriately punctured. Head a little wider but shorter than the thorax, a little longer than broad, a little widened behind the eyes and gradually narrowed in front, the posterior angles rather broadly rounded; median and lateral grooves well marked, not connected; the base, the space between the median grooves, a broad longitudinal space on the disc reaching from the base to the front and a narrow space behind the eyes impunctate, the rest of the surface moderately coarsely and not very closely punctured. Antennae with 2nd and 3rd joints of equal length, the 4th to 10th transverse. Thorax narrowed and sinuate behind, the disc on either side with a row of 7 rather large punctures, externally with a curved row of 7 smaller punctures and two others behind the anterior border on either side. Scutellum alutaceous. Elytra scarcely longer than the thorax, longer than broad, moderately finely, scarcely seriately punctured, the puncturation more confused towards the suture. Abdomen smooth along the middle, the sides very finely and sparingly punctured, with fine sparing stiff pubescence.

Kheri Rau, Siwaliks.

Xantholinus diabolicus n. sp.

Entirely black, shining. Thorax with dorsal row on either side of 14 or 15 small punctures. Elytra very finely, sparingly, super-

ficially punctured. Antennae with the first three joints shining ferruginous, the rest opaque, black; palpi reddish-testaceous. Legs reddish-brown. Length 9·5 mm.

Head oblong-ovate, broader but shorter than the thorax, temples and base coarctate; eyes flat; median grooves parallel, the lateral very fine, linear, nearly transverse; the whole surface except the front finely, sparingly punctured, the temples more closely, the middle impunctate, the temples and supra-ocular area finely coriaceous, the rest of the surface without trace of ground-sculpture. Antennae with the 3rd joint a little shorter than 2nd, 4th to 10th transverse. Thorax (viewed from above) cylindrical, with dorsal row on either side of 14 or 15 small punctures, externally with 9 or 10 others and 7 or 8 following the lateral margin. Elytra broader but scarcely as long as the thorax, a little longer than broad, moderately finely, not very closely, superficially punctured, yet more finely towards the sides, less shining than the fore-parts. Abdomen practically impunctate along the middle, the sides very finely and rather sparingly punctured with fine transversely strigose ground-sculpture.

Chakrata District, Kanasar, 7050 feet above the sea.

Xantholinus (s. str.) **coriaceus** n. sp.

Entirely black, shining, coriaceous. Thorax with dorsal row of 15 or 16 fine punctures on either side. Antennae with the first two joints reddish-brown, the rest black. Legs brownish-testaceous. Length 7·2 mm.

Readily distinguished by the whole body being finely but distinctly coriaceous. Head oblong, shorter but broader than the thorax, the sides straight, scarcely perceptibly narrowed in front, the posterior angles rounded, the base truncate; median furrows broad, slightly convergent posteriorly, the lateral rather broad, shorter than the median; the space between the median furrows and extreme base impunctate, the rest of the surface moderately coarsely and rather closely punctured, less closely on the vertex and finely but distinctly coriaceous especially at the sides. Antennae with 3rd joint a little longer than 2nd, 4th to 10th transverse. Thorax elongate, narrowed and sinuate behind, the disc on either side with a row of 15 or 16 fine punctures, the sides finely, sparingly and irregularly punctured with 2 or 3 larger punctures behind the anterior angles and finely transversely strigose. Scutellum impunctate. Elytra a little longer and broader than the thorax, much longer than broad, finely, moderately closely punctured, finely

coriaceous. Abdomen very finely, sparingly punctured, coriaceous, sparingly pubescent.

Simla Hills: Theog, Kotgarh, 7000 to 7600 feet above the sea.

Xantholinus (s. str.) **modestus** n. sp.

Narrow, elongate, shining black, elytra scarcely metallic; thorax with dorsal row of 16 or 17 somewhat irregular punctures on either side of the middle. First joint of antennae brown, 2nd and 3rd ferruginous, the rest pitchy. Legs reddish-brown. Length 6·4 mm.

Very similar in build to *X. atratus* Heer, but much narrower. Head as broad as the thorax, longer than broad, slightly narrowed anteriorly, the temples slightly rounded and widened, the posterior angles rather broadly rounded, the base truncate; frontal furrows rather wide, slightly converging behind, the lateral short, well marked, not connected with the median, the front and middle of disc broadly impunctate throughout, the rest moderately finely and moderately closely punctured with longitudinal postocular impunctate space. Antennae with 3rd joint a little shorter than 2nd, 4th to 10th transverse, the penultimate about twice as broad as long. Thorax distinctly narrowed and sinuate behind with a row of 17 or 18 small punctures, more or less confused in front, externally with narrow longitudinal impunctate space abbreviated in front, the sides closely and moderately finely punctured. Elytra as long and as broad as the thorax, a little longer than broad, with three not very distinct rows of fine superficial punctures, the reflexed sides finely punctured. Abdomen smooth in the middle, the sides very finely and moderately closely punctured.

Chakrata District; Khedar Khud, 7500 feet above the sea.

Xantholinus (s str.) **piceus** n. sp.

Narrow, elongate, shining, pitchy black. Abdomen brown, the apex, blackish. Head oblong ovate, finely sparingly punctured. Thorax with dorsal row on either side of 15 or 16 rather fine punctures. Antennae with the first three joints shining, ferruginous, the rest pitchy-red, opaque. Palpi testaceous. Legs testaceous. Length 5·75 mm.

Head slightly narrowed in front, the temples slightly widened, coarctate with the base, oval oblong, a little broader but shorter than the thorax, the eyes small; frontal furrows fine, short, parallel, the lateral well marked, not united with the former; puncturation

fine and rather sparing, broadly impunctate along the middle. Antennae with the 3rd joint half as long as 2nd, 4th to 10th transverse, the penultimate about twice as broad as long. Thorax much longer than broad, slightly narrowed and sinuate behind, with a dorsal row on either side of 15 or 16 rather fine punctures, the sides rather closely and finely punctured, leaving a narrow impunctate space adjacent to the dorsal row except in front, where the puncturation is more or less confused with the dorsal row. Scutellum bipunctate, transversely strigose. Elytra a little broader but shorter than the thorax, scarcely longer than broad, pitchy brown, finely superficially subserially and moderately closely punctured, the epipleurae impunctate. Abdomen very finely, moderately closely punctured, finely pubescent.

Dehra Dun district; Nim Nadi. Siwaliks; Mohan Rau.

Othius flavocaudatus n. sp.

Black, shining, elytra reddish-ochraceous; posterior margin of 7th and whole of 8th segment yellow. Antennae black; palpi ferruginous. Legs reddish-brown. Length 11 to 13 mm.

Larger, broader and more robust than *O. punctulatus* Goeze, with broader and more strongly punctured head and different colour. Head subquadrate, a little longer than broad, as wide as the thorax, the temples long, parallel, the posterior angles briefly rounded, frontal furrows rather broad, superficial convergent and bipunctate behind, front and middle of disc broadly impunctate, the rest of the surface rather closely covered with rather large umbilicate punctures. Antennae with the 3rd joint much longer than 2nd, 4th to 7th equal, scarcely longer than broad, 8th to 10th scarcely transverse. Thorax a little longer than broad, widest just behind the rounded anterior angles, more narrowed and sinuate behind; disc impunctate, near the anterior angles with a group of 4 punctures, otherwise impunctate except for the punctures along the extreme lateral margins. Scutellum black, impunctate, coriaceous, subopaque. Elytra less shining than the fore-parts, about as long and as wide as the thorax, a little longer than broad, moderately coarsely and closely punctured except for a narrow impunctate space extending from the shoulder to the postero-external angle, the epipleurae more finely punctured than the disc and with a row of 6 or 7 larger setiferous punctures. Abdomen finely and moderately closely punctured, finely, sparingly pubescent, the sides and apex setiferous.

Chakrata District; Sijla Gad, 5000 feet above the sea.

Othius apicalis n. sp.

Black, shining; apical borders of 7th and 8th abdominal segments yellow; head very sparingly punctured. Antennae with the first two joints pitchy, the rest black. Legs brown. Length 15 mm.

Somewhat of the build but much larger than *O. punctulatus* Goeze. Head a little longer than broad, slightly narrowed in front, the posterior angles rounded, narrower than the thorax; frontal furrows broad and shallow with 2 or 3 fine punctures posteriorly; disc broadly impunctate, the sides and base with sparing rather coarse punctures. Antennae with 3rd joint nearly twice as long as 2nd, 4th and 5th slightly longer than broad, 6th to 10th not or scarcely transverse. Thorax longer than broad, the sides (viewed from above) nearly parallel, disc on either side in front with a large puncture and another near the posterior angles and the usual marginal punctures at the sides and along the anterior border. Elytra as long as and scarcely broader than the thorax, slightly longer than broad, rather coarsely and rather closely punctured, the epipleurae rather more finely and closely. Abdomen finely and not closely punctured, finely, sparingly pubescent.

Mussorie District; Arni Gad. Chakrata District, Chulli Khud, 6500 feet above the sea.

Diochus ochraceus n. sp.

Shining, reddish-ochraceous; abdomen brown, less shining, the posterior margins of the segments and the whole of the 7th and 8th segments ochraceous. Antennae and legs testaceous. Length 3·75 mm.

A narrow fragile species, differing from *D. antennatus* Motsch., in the colour, the much shorter antennae and the practically parallel-sided thorax and closer abdominal puncturation. Head narrower than thorax, scarcely longer than broad, widest at the rather briefly rounded posterior angles, gradually narrowed in front; disc with a row of 3 small punctures on either side, 2 or 3 juxta-ocular and a few fine setiferous ones on the temples. Antennae short, the 2nd and 3rd joints subequal, 4th and 5th scarcely longer than broad, 6th to 10th slightly transverse. Thorax longer than broad, the sides parallel, the anterior and posterior angles rounded; disc on either side with a row of 3 fine setiferous punctures converging behind, externally with two others. Elytra shorter and a little broader than the thorax, scarcely transverse, with a few fine punctures along the suture, a row of 5 or 6 on the disc and a similar

number along the sides. Abdomen extremely finely and rather closely punctured and pubescent, more sparingly behind.

Siwaliks, Mothronwala.

Ctenandropus n. gen.

Facies of a minute *Platyprosopus* Mannerh. Head almost as wide as the thorax, scarcely narrowed behind, porrect and inserted into the thorax. Eyes small, flat, situated anteriorly; anterior border of the front truncate, antennae freely inserted on the front border above the base of the mandible and nearer to the eyes than to each other; gular sutures very fine, separated throughout, slightly converging behind. Labrum transverse, corneous, the angles broadly rounded, broadly, scarcely perceptibly emarginate. Mandibles straight, curved at the tip, each with a small blunt tooth directed forwards and inwards. Inner lobe of the maxilla elongate, the inner margin densely ciliate without teeth; outer lobe truncate in front, ciliate and with 5 or 6 longer cilia externally. Maxillary palpi 4-jointed, the 1st joint very small, 2nd moderate, widened towards apex, 3rd cylindrical longer and narrower than the preceding at apex, 4th subulate about half as long as 3rd. Labial palpi 3-jointed, the 1st joint about twice as long as broad but stout, 2nd narrower and a little shorter than the 1st, 3rd long, acicular, much narrower but fully as long as the preceding. Tongue entirely membranous, broad, triangular, the apex rather broadly rounded. Paraglossae well developed, fusiform, extending for three-fourths the length of the 1st joint of the labial palpi and closely covered with very short bristles. Mentum transverse, truncate anteriorly. Prosternum short without transverse suture or keel, broadly rounded behind, the pronotal epipleurae narrow, not visible when viewed laterally, epimera wanting. Mesosternum short, sharply pointed behind, the intermediate coxae contiguous posteriorly. Tarsi 5, 5, 5; the anterior with the first three joints short, broader than long, the 4th much narrower, about as long as broad, 5th elongate, fully as long as the three preceding together; claws simple: middle with 1st joint about twice as long as 2nd, 2nd and 3rd equal, a little longer than broad, 4th a little shorter than 3rd, 5th elongate; in ♂ the 1st joint furnished beneath with a comb of short stiff black bristles; posterior with the first four joints moderately long, gradually decreasing in length, the 5th longer than the two preceding together. Abdomen bordered. Elytra not sinuate.

Genotype *nigriceps*.

Ctenandropus nigriceps n. sp.

Shining, subdepressed; head black, impunctate; thorax and abdomen fusco-testaceous, 5th and 6th segments infuscate, elytra pitchy. Antennae, palpi and legs testaceous. Length 2·75 mm.

Head black, shining, almost as broad as the thorax, as long as broad, the sides almost straight, posterior angles not visible; eyes small and flat. Sculpture consisting of a puncture near inner border of each eye, two or three on the temples and one on either side before the base, all setiferous; ground-sculpture fine, strigose. Antennae with 2nd and 3rd joints of equal length, 4th to 6th a little longer than broad, 7th to 10th slightly transverse. Thorax scarcely longer than broad, the sides for the anterior three-fourths nearly parallel, posteriorly narrowed, the posterior angles completely rounded with the base, anterior margin truncate; the disc with a puncture on either side, anterior border with a puncture on either side and another against the lateral margins, these with a row of fine setiferous punctures; ground-sculpture as on the head, in certain lights sericeous. Elytra more or less pitchy, as long as and scarcely broader than the thorax, a little longer than broad, finely closely, subasperately punctured and finely pubescent, the sides with 2 or 3 setae. Abdomen nearly parallel, very finely and closely punctured and pubescent, more sparingly on the last two segments, the sides and apex, especially the latter, with long black setae.

♂. First joint of the middle tarsi furnished below with a comb of short black bristles.

Siwaliks; Asarori, Timli. Andaman Islands, Port Blair. A subcortical species of sluggish habit. Has been bred at the Forest Research Institute, Dehra Dun from logs of *Sterculia villosa* from Thano (Siwaliks).

Neobisnius fraternus n. sp.

Narrow, elongate, black shining; elytra dark brown, the suture very narrowly and obscurely rufescent; abdomen coarsely and closely punctured. Antennae brown, the first three joints testaceous. Legs reddish-testaceous. Length 5 mm.

Very similar in build to *N. praelongus* C. and H., but larger and more robust, the head longer, the elytra a little more closely punctured, the abdomen more coarsely punctured and the darker colour. Head a little broader than the thorax, subquadrate, the temples very slightly convergent to the rounded posterior angles and very finely punctured, the disc except the smooth central area less finely and moderately closely punctured, front impressed in the middle

which is impunctate. Antennae with the 2nd and 3rd joints of equal length, 4th slightly longer than broad, 5th to 10th transverse, gradually increasing in breadth. Thorax much longer than broad, narrowed behind, the centre smooth, the sides rather finely and not very closely punctured. Scutellum with a few very fine punctures. Elytra as long as, but a little broader than the thorax, longer than broad, finely and moderately closely punctured. Abdomen parallel, the first four (visible) segments strongly transversely impressed at their bases and very coarsely and closely punctured, the apices and the whole of the 5th and 6th segments much more finely and less closely punctured.

Dehra Dun. In stream shingle.

Actobius affinis n. sp.

Head and thorax black, shining; elytra and abdomen opaque, densely and finely punctured and pubescent. Antennae and legs reddish-testaceous, the middle and posterior tibiae infuscate. Length 4·75 mm.

Very similar to *A. cinerascens* Grav., but differing in the following respects, the antennae are a little longer and differently coloured, the head broader and more shining, the posterior angles more briefly rounded, the puncturation is distinctly coarser and ground-sculpture is wanting, the thorax more shining and without ground-sculpture; the sculpture and pubescence of the elytra and abdomen scarcely differs from that of *A. cinerascens*.

♂. Sixth ventral segment feebly crescentically emarginate.

Dehra Dun and Mussorie Districts.

Philonthus cupreipennis n. sp.

Black, shining. Elytra shining copper-bronze. Abdomen iridescent. Thorax on either side with dorsal row of 4 punctures. Antennae black, long and slender, the penultimate joints distinctly longer than broad. Legs black. Length 12 to 14 mm.

Near *P. proximatus* Schub., but the head and thorax without metallic reflex, the antennae distinctly longer and more slender and the elytra more brilliant and more finely punctured. Head (in ♀) slightly transverse, suborbicular, narrower than thorax, the temples shorter than the eyes, median intra-ocular punctures much nearer the lateral than each other, the disc posteriorly on either side with a row of 3 large punctures (the first of them juxta-ocular) and 4 others behind the eye. Antennae with the 3rd joint distinctly onger than 2nd, 4th to 10th all distinctly longer than broad, 11th

long, oval, longer than 10th. Thorax about as long as broad, slightly narrowed in front, feebly sinuate before the obtuse posterior angles; disc with 4 rather large punctures on either side, equidistant from each other, externally with 3 others and 2 more near the anterior angles. Scutellum black, closely, finely punctured. Elytra as long as and a little broader than thorax, finely and rather closely punctured. Abdomen moderately finely and moderately closely punctured throughout, finely pubescent, the transverse line at the bases of the anterior segments not angled.

♂. Unknown.

West Almora; Dhauli Ganga, 9520 feet above the sea (*R. N. Parker*). In polyporus.

Philonthus riparius n. sp.

Black, shining, elytra green-bronze; head subquadrate, median intra-ocular punctures widely separated; thorax with dorsal row of 4 punctures. Antennae, palpi and legs black. Length 7·5 to 8·5 mm.

Very similar in build to *P. cephalotes* Grav., but the head is a little smaller, the antennae distinctly longer, the puncturation of the elytra finer, that of the abdomen much more sparing. Head suborbicular (in the ♂ larger), a little broader than long, slightly wider in front of the eyes than behind, scarcely narrower than the thorax, the posterior angles rounded, the temples a little shorter than the diameter of the eyes, the inner intra-ocular puncture much nearer the outer than to its fellow, temples finely and closely punctured, between the base and the eye with 4 or 5 punctures. Antennae rather long, the 3rd joint a little longer than 2nd, 4th to 10th distinctly longer than broad, gradually decreasing in length, 11th as long as 10th. Thorax slightly longer than broad, very feebly narrowed in front, the sides nearly parallel, the disc on either side with 4 rather large punctures, the 3 posterior equidistant, externally with 4 others. Scutellum black, finely and closely punctured. Elytra broader than, but as long as the thorax, as long as broad, moderately finely and moderately closely punctured, finely pubescent. Abdomen moderately finely, closely punctured at the bases of the first three segments, much more finely and more sparingly elsewhere, finely and rather sparingly pubescent. First joint of posterior tarsi shorter than the last.

♂. Head broader; anterior tarsi slightly dilated. Sixth ventral segment with a small triangular excision, the margins impressed.

Mussorie District; Mossy Falls, Kolhu Khet. Chakrata

District; Mohna, Binal Gadh, Manjgaon, Chulli Khud. Simla Hills, Kotgarh, Gahan, 5500 to 8000 feet above sea. In stream shingle.

Philonthus punctifrons n. sp.

Black, shining, subdepressed; elytra green-bronze. Head closely and rather finely punctured across the front, the disc with a curved row of 8 large punctures between the eyes. Thorax with dorsal row of 4 punctures on either side. Antennae black; femora brown, tibiae and tarsi pitchy. Length 7 mm.

About the size and build of *P. cephalotes* Gr., but more depressed, with quite differently punctured head, the antennae rather more slender, the scutellum coarsely punctured, the abdomen a little more closely punctured. Head subquadrate, depressed, about as broad as long, a little broader than the thorax, temples a little longer than the eyes, moderately finely and moderately closely punctured, the posterior angles rounded; the front behind the impunctate anterior border, closely and rather finely punctured, between the eyes a semicircular backwardly curved row of 8 rather large punctures, between these and the punctured front, impunctate. Antennae with the 3rd joint longer than 2nd, 4th to 6th slightly longer than broad, 7th to 10th as long as broad. Thorax subdepressed, longer than broad, narrowed behind and distinctly sinuate when viewed from the side, anterior and posterior angles rounded, the disc on either side with 4 rather large punctures, the 3rd and 4th a little further apart than the 2nd and 3rd, externally with 2 or 3 others and behind the anterior angles with 2 or 3 more. Scutellum coarsely and closely punctured. Elytra broader than, but scarcely as long as the thorax, about as long as broad, rather finely and rather closely punctured, and finely pubescent. Abdomen finely and closely punctured and finely pubescent, a little more sparingly behind. First joint of posterior tarsi shorter than the last.

♂. Sixth ventral segment with a small triangular excision. Anterior tarsi simple.

Mussorie District; Keyarkuli. Chakrata District; Chulli Khud, 8000 feet above the sea. In stream débris.

Philonthus puncticeps n. sp.

Black, shining, subdepressed; elytra green-bronze. Head rather closely, finely, irregularly punctured, without conspicuous curved row of large punctures. Thorax with dorsal row of 4 punctures

on either side. Antennae black. Femora brown, tibiae and tarsi pitchy. Length 7 mm.

Very similar to the preceding, but of rather narrower build, the head similarly punctured across the front, but the base, temples and sides of the disc moderately finely and moderately closely punctured, with on either side 2 or 3 larger punctures, the median impunctate area smaller than in the preceding species. The scutellum and elytra are more finely punctured, the abdomen is slightly iridescent, more finely and closely punctured. First joint of posterior tarsi shorter than the last.

♂. Unknown.

Simla Hills; Gahan, 7000 feet above the sea.

Philonthus anepsius n. sp.

Black, shining. Head suborbicular. Thorax narrowed in front, with dorsal row of 5 punctures on either side. Antennae and legs black, the anterior and middle coxae clear testaceous. Length 9 mm.

Very near *P. asemus* Kr., of the same build, but the antennae more slender, the anterior and middle coxae testaceous, the elytra and abdomen more coarsely punctured. Head suborbicular, narrower than thorax, the median intra-ocular punctures widely separated and nearer the lateral than to each other, temples much shorter than the length of the eyes, setiferous. Antennae slender, the 3rd joint longer than 2nd, 4th to 7th distinctly longer than broad, 8th to 10th about as long as broad. Thorax a little longer than broad, distinctly narrowed in front, the disc on either side with a row of 5 moderately large punctures, externally with 2 smaller ones; sides setiferous. Scutellum finely and closely punctured. Elytra a little broader, scarcely longer than the thorax, moderately finely, closely and roughly punctured, the sides with long black setae. Abdomen slightly iridescent, moderately finely and rather closely punctured, more sparingly and finely behind, with rather long coarse pubescence, the posterior margins and sides of the segments with stiff black setae. First joint of posterior tarsi a little longer than the last.

♂. Unknown. ♀. Anterior tarsi strongly dilated.

Siwaliks; Mohan Rau. In dung.

Philonthus gentilicius n. sp.

Black, shining; elytra red, often more or less infuscate posteriorly, the extreme apical margin testaceous. Thorax with dorsal row

of 5 punctures on either side; posterior margins of abdominal segments narrowly rufescent, the bases of the anterior segments coarsely and closely punctured. Antennae with the first 2 and the last 2 or 3 joints reddish-testaceous, the rest infuscate. Legs testaceous. Length 6 to 7 mm.

Allied to *P. circumductus* Fauv., but the head is more orbicular, the antennae are longer, the penultimate joints less transverse, the elytra differently coloured and more closely punctured, the bases of the first three abdominal segments are rather less coarsely punctured. Head transversely suborbicular, a little narrower than the thorax, median intra-ocular punctures widely separated, nearer the lateral, temples with 2 or 3 fine punctures and on either side with a row of 3 punctures between the posterior border of the eye and the base, all the punctures setiferous. Temples a little shorter than the eyes. Antennae with 3rd joint a little longer than 2nd, 4th scarcely longer than broad, 5th and 6th as long as broad, 7th to 10th slightly transverse. Thorax a little longer than broad, scarcely narrowed in front, the sides nearly parallel when seen from above; disc on either side with 5 moderate punctures, the anterior and posterior the more remote of the series, externally with 2 others and 2 more behind the anterior angles. Scutellum densely, moderately coarsely punctured. Elytra convex, a little broader but scarcely as long as the thorax, about as long as broad, finely but not closely punctured, red, usually with a more or less infuscate area behind the middle, not quite extending to the suture or the lateral and posterior margins, these very narrowly testaceous. Abdomen moderately coarsely and closely punctured at the bases of the first 3 segments, much more finely elsewhere, pubescence fine, yellowish.

♂. Anterior tarsi moderately dilated. Sixth ventral segment with small triangular excision, the margins smooth and shining.

Chakrata District; Manjgaon, Bangar, Mohna. Mussorie District; Arni Gad. Dehra Dun; Siwaliks, 2500 to 6000 feet above the sea. In damp places near streams.

Philonthus fraternus n. sp.

Black, shining; elytra red very finely, sparingly punctured; abdomen entirely black, finely, moderately closely, uniformly punctured on the anterior segments, the 5th and 6th more finely and sparingly. Thorax with dorsal row of 5 punctures on either side. Antennae with the 1st joint pitchy above, ferruginous below, 2nd ferruginous ringed with brown, 11th testaceous, the rest black. Legs brown, the tarsi fusco-testaceous. Length 7·2 mm.

Scarcely differing in build from the preceding, but the antennae have the penultimate joints a little more transverse, the legs are dark, the elytra more finely and sparingly punctured, the abdomen entirely black, the bases of the anterior segments without coarse puncturation. From *P. circumductus* Fauv., it differs in the sub-orbicular head, darker antennae and legs, more finely and more closely punctured elytra and absence of coarser puncturation at the bases of the anterior abdominal segments.

♂. Unknown.

Simla Hills; Kotgarh, 7000 feet above the sea. At edge of stream.

Philonthus speciosus n. sp.

Head and abdomen black; thorax red with dorsal row of 5 punctures on either side; elytra black, the base and sutural margin narrowly, the sides and apical margins more broadly reddish-testaceous. Antennae with the first two joints testaceous, the rest blackish. Legs testaceous. Length 4 mm.

Head orbicular, a little narrower than the thorax, the temples shorter than the eyes; median intra-ocular punctures widely separated, behind the eyes on either side with an oblique row of 3 punctures, temples finely, rather closely punctured. Antennae with 2nd and 3rd joints of equal length, 4th and 5th slightly longer than broad, 6th as long as broad, 7th to 10th slightly transverse. Thorax a little longer than broad, the sides parallel, on either side with a row of 5 small punctures, externally with 2 others. Elytra as long as but broader than the thorax, about as long as broad, moderately finely and moderately closely punctured, finely pubescent. Abdomen finely, closely punctured and pubescent, more sparingly on the last two segments.

Dehra Dun.

Philonthus densus n. sp.

Black, shining; elytra bronze-black. Thorax with dorsal row of 5 punctures on either side. Abdomen exceedingly finely and densely punctured and pubescent, sericeous. Antennae black. Anterior coxae and the femora more or less testaceous. Length 7·5 mm.

Size and build of *P. ventralis* Gr., but the antennae are more slender, the eyes larger, the elytra more finely and the abdomen much more finely and closely punctured and pubescent much as in *P. sanguinolentus* Gr. Head transversely subquadrate in ♂ as

broad as the thorax, the eyes large, longer than the temples, median intra-ocular punctures widely separated, behind the eyes with an oblique row of 3 punctures, the temples with 4 or 5 others. Antennae with the 3rd joint a little longer than 2nd, 4th to 10th all longer than broad, gradually decreasing in length, the 10th not much longer than broad, a little shorter than 11th. Thorax a little longer than broad, the sides nearly parallel, very slightly narrowed in front, on either side of the disc with a row of 5 moderately large punctures and externally with 3 others; sides setiferous. Scutellum densely and finely punctured. Elytra a little broader, but scarcely longer than the thorax, slightly transverse, less shining than the fore-parts, finely and closely punctured, finely pubescent, the sides setiferous. Abdomen extremely finely and very densely punctured and pubescent throughout, sericeous.

♂. Anterior tarsi dilated. Sixth ventral segment with small triangular excision, the margins smooth and shining.

Chakrata District; Chulli Khud, Sainj Khud, Korawa Khud, 6500 to 8000 feet above the sea. In dung.

Philonthus chatterjeei n. sp.

Black, shining; head suborbicular. Thorax with dorsal row of 5 punctures on either side of the disc. Elytra very finely and sparingly punctured. Palpi pitchy. Antennae black, the last joint obscurely testaceous. Legs pitchy, the tarsi testaceous. Length 5·5 mm.

Very similar in size and build to *P. acroleucus* Kr., but more robust, the antennae a little longer, the penultimate joints less transverse, the 1st joint black, the legs dark, the scutellum much more coarsely punctured, the elytra more sparingly punctured and the abdomen much more sparingly punctured. Head suborbicular, narrower than the thorax, the eyes a little shorter than the temples, median intra-ocular punctures distant from one another, between the eye posteriorly and the base, with an oblique row of 3 punctures, temples with 2 or 3 punctures. Antennae with 3rd joint scarcely longer than 2nd, 4th and 5th slightly longer than broad, 6th to 10th slightly transverse. Thorax slightly longer than broad, slightly narrowed in front, on either side of the disc with a row of 5 punctures of which the 4 posterior are equidistant, externally with 2 or 3 others. Scutellum closely and rather coarsely punctured. Elytra a little broader, but as long as the thorax, as long as broad, finely and only moderately closely punctured, the sides setiferous. Abdomen black, shining, finely

and not very closely punctured and finely pubescent. First joint of posterior tarsi longer than the last.

♂. Unknown.

Mussorie District; Arni Gad. In stream débris.

Philonthus beesoni n. sp.

Black, shining. Antennae with penultimate joints longer than broad. Thorax with dorsal row of 5 punctures on either side of disc. Elytra very finely and moderately closely punctured. Antennae, palpi and legs dark, femora pitchy. Length 7 mm.

Size and build of *P. ventralis* Gr., but the antennae are more slender, the penultimate joints a little longer than broad, the eyes larger, the puncturation of the elytra a little finer and a little closer, that of the abdomen much closer, the ground-sculpture of the fore-parts much less distinct. Head subquadrate, narrower than the thorax, the posterior angles rounded, the eyes longer than the temples, median intra-ocular punctures more distant from each other than from the lateral ones, between the eye and base with an oblique row of 3 punctures, temples with 3 or 4 punctures. Antennae with 3rd joint a little longer than 2nd, 4th to 10th all longer than broad, gradually decreasing in length, 11th a little longer than 10th. Thorax about as long as broad, slightly narrowed in front, on either side of disc with a row of 5 moderately large punctures and 2 others externally. Scutellum finely and rather closely punctured. Elytra a little wider but about as long as thorax, finely and moderately closely punctured and pubescent. Abdomen very finely and moderately closely punctured and pubescent, a little more sparingly behind. First joint of posterior tarsi longer than the last.

♂. Anterior tarsi dilated. Sixth ventral segment with smooth triangular impression which is triangularly excised at base.

Simla District; Gahan, Matiana, Theog. Fagu, 7000 to 8000 feet above the sea. Chakrata District; Binal Gad, 7000 to 8000 feet above the sea. In the stream shingle.

Philonthus siwalikensis n. sp.

Black, shining; the elytra more opaque, slightly bronzed. Thorax with dorsal row on either side of 6 punctures. Abdomen with the bases of the first 5 visible segments very closely and moderately coarsely punctured. Palpi reddish-testaceous. Antennae with 1st joint reddish-testaceous, the last one or two somewhat

obscure testaceous. Femora and tarsi testaceous, the tibiae pitchy-black. Length 9 mm.

Near *P. fumarius* Gr., but rather less robust, the head rather broader, the thorax more parallel-sided, the elytra not quite so closely punctured, the abdomen much more closely and much less finely punctured at the bases of the segments: the structure of the antennae and the colour of the elytra are practically the same as in *P. fumarius*. Head suborbicular, narrower than the thorax, a little narrowed behind, the eyes large, longer than the temples, the median intra-ocular punctures widely separated, much nearer the lateral ones than to each other; between the eye and the base with a curved row of 4 punctures, temples with a few fine punctures. Antennae with the 3rd joint considerably longer than 2nd, 4th to 10th all longer than broad, gradually decreasing in length, the 10th only a little longer than broad. Thorax slightly longer than broad, scarcely narrowed in front, the sides nearly parallel when viewed from above; disc on either side with 6 moderate punctures, externally with 2 others, finely transversely strigose. Scutellum finely, closely, asperately punctured. Elytra broader but about as long as the thorax, finely and closely punctured and pubescent. Abdomen closely and moderately coarsely punctured at the bases of the first 5 visible segments, less closely and more finely elsewhere. First joint of posterior tarsi longer than the last.

♂. Anterior tarsi dilated. Sixth ventral segment with rather long, narrow triangular smooth impression in the middle posteriorly, the base nearly semicircularly excised.

Siwaliks; Kheri Rau, Mohan Rau, Lachiwala, Song River. At the edges of the water.

Philonthus persimilis n. sp.

Very near the preceding, but differs in the 1st joint of the antennae being entirely black, the palpi pitchy, the legs entirely dark, the elytra rather more coarsely punctured. In the ♂ the 6th ventral segment is more broadly and less deeply excised.

Siwaliks; Kheri Rau, Song River. Mussorie District; Aglar River, Arni Gad, Keyarkuli, 6000 feet above sea. Simla District; Fagu, 8000 feet above the sea. Of similar habit to the preceding.

Philonthus masuriensis n. sp.

Black, shining, elytra pitchy-black or pitchy-brown; thorax with dorsal row of 6 punctures. First joint of antennae pitchy or

pitchy-testaceous, the penultimate joints scarcely transverse: femora testaceous, the tibiae and tarsi pitchy. Length 6·75 to 7 mm.

Of similar build and closely allied to *P. micans* Gr., but the head is shorter, and broader (especially in ♂), the antennae are shorter, the penultimate joints very slightly transverse, the elytra a little less finely and less closely punctured and without ground-sculpture and a little shorter, the abdomen is very similarly punctured but the pubescence is rather less coarse. Head (in ♂) large, subquadrate as broad as the thorax, in ♀ suborbicular narrower than the thorax, the temples a little longer than the eyes, median intra-ocular punctures distant, nearer to the lateral ones than to each other, disc on either side behind with 2 punctures and one midway between the posterior border of the eye and the base, ground-sculpture very fine, transversely strigose. Antennae with 2nd joint shorter than 3rd, 4th and 5th slightly longer than broad, 6th and 7th as long as broad, 8th to 10th slightly transverse. Thorax about as long as broad, a little narrowed in front, the sides (viewed from above) straight, the disc on either side with a row of 6 moderate punctures and externally with 2 others, near the lateral margin with 3 more, ground-sculpture similar to the head and in certain lights sericeous. Scutellum closely and moderately finely punctured. Elytra broader than and about as long as the thorax, finely and rather closely punctured, finely pubescent and without ground-sculpture. Abdomen very finely and closely punctured and pubescent throughout.

♂. Head broader, subquadrate; anterior tarsi dilated; 6th ventral segment with a deep smooth triangular impression the base of which is triangularly excised; 5th with a very small arcuate emargination in the middle of the posterior border.

Mussorie district; Dhobi Ghat. Chakrata District; Bodyar. Simla Hills; Kotgarh, 5000 to 8000 feet above the sea. In dung.

Philonthus (Gabrius) lineifrons n. sp.

Black, shining, elytra brownish-testaceous darker at the scutellum and along the suture. Thorax with dorsal row of 5 punctures on either side. Antennae black, the 1st joint pitchy. Legs testaceous, the tibiae pitchy. Length 4 to 4·5 mm.

Near *P. thermarum* Aubé, but darker coloured, more robust with longer antennae, less finely punctured elytra and less closely punctured abdomen and with a narrow deeply impressed line on the front, often extending as far as the vertex. Head oblong,

narrower than the thorax, the temples longer than the diameter of the eyes, median intra-ocular punctures widely separated, the front narrowly, deeply impressed, vertex on either side with 2 obliquely placed punctures, temples with 3 punctures, 2 of them against the eye. Antennae with 3rd joint a little longer than 2nd, 4th slightly longer than broad, 5th and 6th about as long as broad, 7th to 10th very slightly transverse. Thorax a little longer than broad, the sides parallel, the disc on either side with a row of 5 punctures, externally with 5 others. Scutellum black, with 7 or 8 punctures. Elytra broader and a little longer than the thorax, longer than broad, moderately finely and moderately closely punctured. Abdomen finely and moderately closely punctured, rather more sparingly on the 7th and 8th segments, finely pubescent.

♂. Sixth ventral segment with small triangular impression, the base of which is very feebly crescentically emarginate.

Simla and Chakrata districts, 7000 to 8000 feet above the sea. In dung and vegetable débris.

Hesperus gridellii n. sp.

Shining blue-black; elytra metallic green; abdomen black scarcely iridescent. Antennae, maxillary palpi and mandibles black. Legs black. Length 13·2 mm.

Head large, transversely subquadrate, fully as broad as the thorax, eyes large, temples short, the posterior angles rounded, median intra-ocular punctures more distant from each other than from the lateral ones, temples and before the base with moderately coarse and moderately close setiferous punctures. Antennae slender, the 3rd joint much longer than 2nd, all the rest distinctly longer than broad, gradually decreasing in length, 11th as long as 10th. Thorax slightly transverse in ♂, about as broad as long in ♀, the sides (viewed from above) almost straight, the disc on either side with a row of 4 rather large punctures, externally with a group of 3 smaller ones, behind the anterior angles with 3 more, all setiferous. Scutellum black, moderately coarsely and rather closely punctured. Elytra a little longer and broader than the thorax, about as long as broad, of a beautiful metallic green colour, moderately finely and not very closely punctured, finely setiferous. Abdomen with the first 3 (visible) segments with a transverse row of moderate punctures at the base and a row of smaller ones nearer the posterior margin, which itself is closely punctured, 4th to 6th segments more finely, more irregularly and more sparingly punctured, especially the last.

♂. Head broader. Sixth ventral segment with rather broad triangular excision, the margins of which are impressed.

Almora, Kali Valley, 9000 feet above the sea. In fungus.

Hesperus cingulatus n. sp.

Shining; head black; thorax red; elytra black, the disc broadly brassy, with the base and shoulders broadly, the suture narrowly rufescent, the postero-external angles and posterior margins testaceous; abdomen black, the posterior half of the first 3 (visible) segments red, the posterior margin of the 5th testaceous. Antennae black, the last 2 joints pale yellow; maxillary palpi and mandibles reddish. Legs reddish-testaceous, the tibiae yellow, infuscate towards the apex. Length 9 mm.

Near *H. wasmanni* Fauv., but differing in the following respects, the whole insect is much more closely and coarsely punctured, the base of the elytra is much more narrowly red, the posterior margins less broadly testaceous and the abdomen differently coloured. Head slightly transverse, subquadrate, the temples slightly convergent behind, the posterior angles rounded, near the antennal tubercles on either side with 3 or 4 punctures, the temples and before the base rather coarsely, closely punctured, the disc smooth. Antennae with 3rd joint longer than 2nd, 4th and 5th slightly longer than broad, 6th to 8th as long as broad, 9th and 10th slightly transverse. Thorax a little longer than broad, the sides (viewed from above) narrowed and sinuate behind, the median line broadly smooth, the sides irregularly, moderately coarsely and moderately closely punctured, the punctures setiferous. Scutellum black, closely and moderately finely punctured. Elytra broader than, but as long as, the thorax, square, moderately finely and moderately closely punctured, pubescence fine and yellow, and with a few fine erect setae. Abdomen with the first 3 (visible) segments closely and moderately finely punctured at the bases, the following more finely and more irregularly punctured, pubescence scanty, yellow, the sides with moderate black setae.

♂. Sixth ventral segment with a small crescentic emargination of the posterior border.

Mussorie district, Arni Gad. Chakrata district, Bangar. Simla Hills, Theog, 6000 to 7600 feet above the sea. In damp leaves near streams.

Tolmerinus abdominalis n. sp.

Black, subopaque, the posterior margin of the 5th (visible) and whole of the 6th abdominal segments obscurely rufescent; the

base and shoulders of the elytra, the whole of the 1st (visible), the base of the 3rd at the sides, the whole of the base of the 4th and the base and apex of the 5th abdominal segments, golden pubescent. Antennae black, the 1st, 10th and 11th joints rufescent, maxillary palpi reddish. Legs pitchy brown, tarsi rufescent. Length 13 mm.

Head suborbicular, narrower than the thorax, densely, moderately finely subrugosely punctured, moderately closely covered with yellowish pubescence, and with a more or less distinct fine median shining line throughout. Antennae with 3rd joint longer than 2nd, 4th to 6th slightly longer than broad, 7th and 8th about as long as broad, 8th and 10th slightly transverse. Thorax a little longer than broad, very slightly narrowed behind, the sides almost straight (as seen from above), viewed laterally, broadly sinuate posteriorly, the lateral seta distant from the deflexed margin, sculpture similar to that of the head, but without a median line, pubescence fine, yellow, the sides with 2 long black setae. Scutellum densely and finely punctured. Elytra a little wider than the thorax, square, densely and more finely and roughly punctured than the fore-parts, pubescence fine and yellow, denser at the base and shoulders forming a more or less distinct patch in certain lights, near the scutellum with a setiferous puncture, the sides with 3 long black setae. Abdomen very finely and densely punctured at the bases of the segments, much more sparingly towards the posterior margins, the 1st (visible) segment covered with fine yellow pubescence throughout, the 3rd with a somewhat obscure patch of similar pubescence on either side, the 4th with a transverse fascia at the base, not so dense, however, as that of the 1st segment, the 5th with more or less distinct basal and apical fasciae, the other areas of the segments with a scanty black pubescence and numerous erect black setae.

♂. Unknown.

Dehra Dun.

Tolmerinus inornatus n.sp.

Entirely black, greasy lustrous; 7th abdominal segment narrowly and obscurely rufescent posteriorly. Antennae with the first 2 joints and the last more or less ferruginous. Legs pitchy, tarsi rufescent. Length 13 mm.

Similar to the preceding in size and build, but differing in the following respects, the entire absence of yellow pubescence, the much finer and less close puncturation of the head and thorax and less close abdominal sculpture.

♂. Sixth ventral segment with crescentic excision.

Mussorie district; Arni Gad.

Tolmerinus trifasciatus n. sp.

Black, subopaque, densely punctured; abdomen rather shining black, the 8th segment ferruginous, the apex of the 3rd and bases of the 6th and 7th segments thickly clothed with golden yellow pubescence, the sides of the 4th and 5th obscurely yellow pubescent. Antennae with the first two joints and apex of the last more or less ferruginous. Legs pitchy. Length 9 mm.

Head transversely suborbicular, narrower than the thorax, neck about $\frac{1}{3}$ the breadth of the head; eyes rather small, disc in front with a fine median raised line, otherwise densely, moderately finely, umbilicately punctured; temples each with 2 setae. Antennae with 3rd joint longer than 2nd, 4th to 6th a little longer than broad, gradually decreasing in length, 7th as long as broad, 8th to 10th slightly transverse. Thorax a little longer than broad, widest just behind the rounded anterior angles, a little narrowed and sinuate behind (as seen from above), posterior angles broadly rounded, the lateral seta distant from the deflexed margin, densely punctured like the head without smooth median line. Scutellum densely and finely punctured. Elytra a little broader but shorter than the thorax, as long as broad, densely, rather finely, transversely rugosely punctured, pubescence fine and yellow, near the scutellary margin with a setiferous puncture, the sides with 3 long setae. Abdomen very finely and closely punctured with fine black pubescence and with yellow fasciae as above described, the sides and posterior margins of the segments with black setae.

♂. Sixth ventral segment with a crescentic emargination; 5th with a round fovea in the middle, with shining fundus.

In sculpture, abdominal pubescence and to some extent the ♂ characters this species would appear to be very similar to *Anisolinus fasciventris* Fauv., but the not especially thickened 2nd joint of the maxillary palpi, the separation of the lateral seta of the thorax from the deflexed margin and the narrow neck would appear to indicate its position in *Tolmerinus*.

Tolmerinus rufipes n. sp.

Head and thorax black, shining; elytra and abdomen less shining, the former red, the latter black with the posterior margin of 7th segment narrowly rufescent. Antennae reddish, the 4th to 8th joints pitchy. Legs reddish-testaceous. Length 9 mm.

Head orbicular, narrower than the thorax, exceedingly finely, rather closely punctured, the disc impunctate, with 3 long setae,

one behind the insertion of the antennae, one juxta-ocular and one temporal, pubescence fine and greyish. Antennae with 3rd joint longer than 2nd, the following all longer than broad, gradually decreasing in length. Thorax a little longer than broad, narrower in front, the sides (seen from above) very slightly curved, slightly sinuate behind when viewed laterally, the lateral seta near the reflexed margin, the angles broadly rounded, puncturation exceedingly fine and rather close, on either side of the disc with a row of 4 obsolete punctures, pubescence fine and greyish. Scutellum pitchy, densely and finely punctured. Elytra a little wider, but scarcely so long as the thorax, slightly transverse, closely and finely punctured and pubescent, on either side of the scutellum with a setiferous puncture, the sides with 4 or 5 others, posterior margin with some fine black setae. Abdomen a little narrowed towards apex, not iridescent, very finely and very closely punctured and pubescent, especially towards the bases of the segments, the 8th more shining and sparingly punctured; apical margins and sides with black setae.

♂. Anterior tarsi dilated; 6th ventral segment with small triangular excision, the sides of which are narrowly impressed. ♀ unknown.

Mussorie district; Arni Gad.

Tolmerinus ruficollis n. sp.

Head black, shining; thorax red, shining; elytra black, moderately shining; abdomen black, iridescent, the 7th segment rufescent. Antennae dark, the 1st and 11th joints reddish. Legs reddish, the tibiae infuscate. Length 8 mm.

A little more robust than the preceding, with less finely punctured head and smaller impunctate discal area, shorter stouter antennae, the penultimate joints slightly transverse, the thorax, however, is exceedingly finely and moderately closely punctured much as in the preceding species, and with 4 very obsolete punctures on either side, viewed laterally the sides are more strongly sinuate behind; the elytra are less finely punctured, the abdomen is rather strongly iridescent and the bases of the segments less finely punctured.

♂. Sixth ventral segment with rather deep triangular excision.

Dehra Dun.

Craspedomerus bernhaueri n. sp.

Shining; head and thorax bronze-green; elytra brick-red; abdomen black iridescent, the posterior margin of the 7th segment narrowly, the 8th broadly rufescent. Antennae black, the last 2 or

3 joints obscure fusco-testaceous : maxillary palpi with the last joint testaceous, the preceding blackish. Legs reddish. Length 12 to 13 mm.

Differs from *C. glenoides* Schub., in the obscure colour of the terminal antennal joints, the less distinctly rufescent apical abdominal segments and the less distinct ground-sculpture of the head and thorax.

Head broad, transversely sub-quadrate, in the ♂ a little broader, in the ♀ as broad as the thorax, the temples rather broadly rounded, closely and finely punctured, setiferous : median intra-ocular punctures nearer to each other than to the lateral ones, behind the anterior border with 2 finer punctures; disc impunctate, the base and sides behind the eyes rather closely sculptured with fine and moderately fine punctures; ground-sculpture distinct more or less transverse and wavy. Antennae with 3rd joint much longer than 2nd, the following all longer than broad, gradually decreasing in length, the penultimate but little longer than broad, 11th as long as 10th. Mandibles dark brown. Thorax a little longer than broad, widest in front, the sides (viewed from above) gradually narrowed posteriorly in a nearly straight line, the posterior angles rounded, viewed laterally slightly sinuate; the whole of the middle line broadly impunctuate throughout, the sides rather closely set with moderately fine punctures, rather smaller externally; ground-sculpture as on the head; pubescence scanty, yellowish, the sides with a long black seta and several shorter ones. Scutellum pitchy, closely and finely punctured. Elytra less shining than the fore-parts, as long as, but a little wider than the thorax, about as long as broad, very finely and closely punctured, and with a fine yellowish pubescence. Abdomen a little narrowed behind, finely and closely punctured at the bases of the segments, more sparingly towards the posterior margins, 7th and 8th segments much more sparingly and more evenly punctured, pubescence black, stiff, moderately close and with a few longer black setae.

♂. Head broader; anterior tarsi more dilated. Sixth ventral segment with small triangular excision, the sides narrowly impressed.

Chakrata district. In damp places near streams.

Heterothops indica n. sp.

Black shining, posterior margin of the elytra narrowly and obscurely testaceous. Head suborbicular. Antennae with 1st joint pitchy-testaceous. Legs testaceous, the tibiae more or less infuscate. Length 4·2 mm.

On the average smaller and narrower than *H. oculata* Fauv.,

with longer eyes and shorter temples, thorax more narrowed anteriorly and the elytra more sparingly punctured; from *H. quadripunctula* Gr., by the larger size, broader head, stouter antennae, more coarsely and less closely punctured elytra. Head suborbicular, the eyes large, the temples short, the posterior angles completely effaced; with 3 juxta-ocular punctures, 3 post-ocular and 2 on either side before the base and with a fine strigose ground-sculpture. Antennae with 3rd joint a little shorter than 2nd, 4th to 7th slightly longer than broad, 8th to 10th about as long as broad. Thorax about as long as broad, narrowed in front, the sides almost straight, on either side in front with a puncture and another on the anterior border itself. Elytra a little broader but as long as the thorax, finely and not very closely punctured, finely pubescent. Abdomen rather finely and moderately closely punctured and pubescent throughout, moderately shining.

Mussorie district; Arni Gad. Chakrata and Simla Hills.

Quediosoma n. gen.

Somewhat similar in facies to *Quedius laevigatus* Gyll. Neck broad, about half the width of the head, this exserted; gular sutures feeble, united behind; infraorbital keel evanescent behind; antennae serrate from the 4th to 9th joints. Labrum transverse, rounded in front, acutely triangularly excised in the middle of the anterior border. Mandibles rather slender, pointed, each with an obscure tooth about the middle, basal half with ciliated membrane. Maxillary palpi with the 1st joint very short, 2nd moderately elongate, lightly curved and thickened apically, 3rd about as long as the preceding, 4th as long as, but narrower than 3rd, pointed. Outer lobe of maxilla broad, densely ciliate at apex; inner lobe pointed, densely ciliate at apex and along inner border. Labial palpi elongate, 1st joint a little shorter than 2nd, 3rd a little longer than preceding, pointed. Tongue small, rounded in front. Paraglossae well developed, extending to the apex of 1st joint of labial palpi. Prosternum obtusely rounded behind; epipleurae strongly reflexed, the inner margin not united with the lateral border of the pronotum in front, the anterior angles of the pronotum not much produced beyond those of the prosternum. Epimera wanting. Mesosternum triangular, bluntly pointed behind and extending to the posterior third of the coxae, these rather widely separated. Intersternal piece short, separated from the metasternum by a fine suture and similarly separated from the mesosternum. Anterior tibiae finely pubescent, intermediate and posterior with a few fine spines. Anterior tarsi with the first 3 joints dilated in both sexes; intermediate and posterior

with 1st joint a little longer than 2nd and 3rd together, 2nd, 3rd and 4th gradually decreasing in length, 5th shorter than 1st.

Allied to *Velleius* and *Quedius*, differs from both in the uncovered stigmata of the prothorax and the rather widely separated middle coxae.

Type : *termitophaga*.

Quediosoma termitophaga n. sp.

Black, shining, the anterior angles and margins (very narrowly) of the thorax rufescent. Elytra reddish-testaceous, less shining than the fore-parts. Abdomen black, extremely finely and densely punctured and pubescent, sericeous. Antennae reddish-testaceous, the intermediate joints more or less infuscate; palpi and mandibles reddish. Legs reddish-testaceous. Length 8·2 mm.

Head broad, transversely subquadrate, almost as broad as the thorax in the ♂, a little narrower in the ♀; temples short, the posterior angles rounded, the eyes large; intra-ocular punctures equidistant, disc on either side with a curved row of 4 fine punctures, temples finely and sparingly punctured, before the base on either side with a puncture, all the punctures with black setae. Antennae with the 3rd joint a little shorter than 2nd, the 4th to 9th obconical, serrate, about as long as broad, 10th as long as broad, 11th oval, longer than 10th. Thorax as long as broad, the sides (seen from above) nearly straight, narrower in front than behind, the posterior angles broadly rounded, the anterior deflexed, rounded; disc on either side with a row of 5 fine punctures, externally with an irregular group of 5 or 6 others equally fine, sides with a few fine setae. Scutellum pitchy, very finely and closely punctured, finely pubescent. Elytra a little broader than the thorax, as long as broad, very finely and rather closely punctured and with a fine yellow pubescence, the sides with a few black setae. Abdomen with the first 5 (visible) segments exceedingly finely and densely punctured and pubescent, sericeous, 6th shining, finely and sparingly punctured. Pro-, meso- and meta-sterna entirely reddish.

♂. Sixth ventral segment with triangular excision.

Dehra Dun. I have only found this species after exposing the combs of *Hodotermes obesus*, when it quickly appears on the scene and attacks the young; under no other circumstances have I met with it.

Quedius (Microsaurus) sodalis n. sp.

Entirely black, shining; thorax narrower than elytra with a dorsal row of 3 punctures and externally with 3 others. Scutellum

smooth; elytra moderately coarsely, rather closely punctured. Antennae and mouth-parts dark. Femora and tarsi pitchy-brown, tibiae black. Length 12 mm.

Near *Q. mesomelinus* Marsh., but the eyes a little larger and temples shorter and less rounded, antennae longer and more slender, the penultimate joints as long as broad, the thorax narrower and the sides less rounded, the puncturation of the elytra is much less fine and deeper. Temples scarcely rounded, shorter than the eyes with 1 or 2 punctures, against the eyes with 2 others, before the base on either side with 2 more placed obliquely. Antennae with 3rd joint almost twice as long as 2nd, 4th to 7th slightly longer than broad, gradually decreasing in length, 8th to 10th about as long as broad. Thorax about as long as broad, the sides but slightly rounded not impressed, narrower in front, disc with a dorsal row of 3 punctures on either side and externally with 3 others of which the first 2 are nearer together and near the anterior margin, between these and the anterior angles with another. Scutellum smooth. Elytra scarcely wider than the thorax, as long as broad, moderately coarsely, deeply and moderately closely punctured and with a fine greyish pubescence. Abdomen parallel, finely and moderately closely punctured and pubescent throughout, scarcely more sparingly behind.

Simla Hills, Fagu, 8000 feet above the sea. Under stone.

Quedius (Microsaurus) adjacens n. sp.

Very near the preceding but differing as follows, the temples are more rounded, the sides of the thorax more rounded, the puncturation of the elytra much finer and more superficial, the legs including the tarsi are entirely black. From *Q. mesolinus* Marsh., it is distinguished by the shorter temples, longer antennae, less rounded sides of the thorax and entirely black legs, the puncturation of the elytra is similar to that of *mesomelinus*.

♂. Sixth ventral segment with small smooth impression in the middle of the posterior border, the base of which is crescentically emarginate.

Chakrata district; Deoban, 9300 feet above the sea. Under dry dung.

Quedius (Sauridus) ripicola n. sp.

Black, shining, the margins of the thorax very narrowly, obscurely rufescent, apex of the scutellum rufescent, elytra sometimes pitchy or brown. Head with 4 intra-ocular punctures. Antennae dark, the first 2 joints pitchy-red. Legs reddish-brown. Length 8·5 mm.

Of the general facies and colour of *Q. umbrinus* Er., but larger, the eyes smaller, the temples less rounded, straighter, the front with 4 punctures, antennae much longer, puncturation of the elytra less fine and less close, that of the abdomen not so fine. Eyes longer than the temples, these very slightly rounded with 4 or 5 setiferous punctures, median intra-ocular punctures very superficial, a little nearer the lateral ones than each other, disc with 3 obliquely placed post-ocular punctures on either side. Antennae slender, 3rd joint longer than 2nd, 4th to 6th a little longer than broad gradually decreasing in length, 7th to 10th about as long as broad. Thorax slightly transverse, narrower in front, the sides feebly rounded, the posterior angles completely rounded; disc on either side with an oblique row of 3 punctures situated anteriorly, 2 others externally and 3 intermediately. Scutellum smooth. Elytra as long as but a little narrower than the thorax, a little longer than broad, moderately coarsely and moderately closely punctured, finely grey pubescent. Abdomen gradually narrowed posteriorly, scarcely iridescent, finely, moderately closely punctured, more finely and sparingly behind, pubescence fine and grey.

♂. Sixth ventral segment with small smooth triangular impression in the middle of the posterior border, the base of it feebly crescentically emarginate.

Mussorie, Chakrata and Simla districts, 6000 to 9000 feet above the sea. At the margins of streams.

Quedius (Raphirus) fluviatilis n. sp.

Black, shining, head orbicular without frontal punctures. Elytra pitchy, the shoulders and postero-external angles more or less broadly, suture and posterior margins narrowly, rufotestaceous. Posterior margins of the abdominal segments occasionally very narrowly reddish. Antennae pitchy, the 1st joint fusco-testaceous. Legs reddish-testaceous. Length 7 to 8 mm.

Only differs from *Q. semiaeneus* Steph., in the colour, the shorter and less densely punctured elytra and the much less densely punctured, non-sericeous abdomen. The antennal structure is practically the same.

♂. Sixth ventral segment with a small crescentic emargination in the middle of the posterior border.

Chakrata district, 6000 to 9300 feet above the sea. At the borders of streams.

Quedius anomalus n. sp.

Very black, shining; thorax with dorsal row of 3 punctures; elytra moderately coarsely and moderately closely punctured, with row of 6 sutural, 6 humeral and 2 intermediate larger punctures. Antennae and legs black. Length 10 mm.

In general facies very similar to *Q. picipes* Mannh., except that the head is shorter and more orbicular and the eyes larger and temples shorter, much as in the sub-genus *Raphirus*. The elytra are less finely and a little less closely punctured, the abdomen is not iridescent and is rather more coarsely and less thickly punctured. The 2 large intermediate punctures are placed about the level of the 4th and 5th of the sutural row. The antennae have the same build as *picipes*.

♂. Sixth ventral segment with rather large triangular excision.

Mussorie district; Dhobi Ghat.

Quedius chatterjeei n. sp.

Black, shining, the anterior angles of the thorax often more or less testaceous, the elytra shining metallic green with 4 rows of larger punctures. Antennae and mouth-parts black, coxae and femora testaceous, the tibiae and tarsi pitchy. Length 5·5 to 8·75 mm.

Build and average size of *Q. paradisianus* Heer. Head suborbicular, very slightly broader than long, eyes large, temples very short, very finely punctured, in front with 4 inter-ocular punctures of which the median are nearer to the lateral than to each other, posteriorly with 2 large post-ocular punctures on either side. Antennae with 3rd joint considerably longer than 2nd, 4th and 5th a little longer than broad, 6th and 7th about as long as broad, 8th to 10th scarcely transverse. Thorax formed as in *Q. paradisianus* Heer, the disc with an oblique row of 3 punctures on either side, a row of 3 others along the anterior margin, 2 others external to the dorsal row of which the posterior one is on a level with the hindmost of the dorsal series and another against the lateral margin itself. Scutellum impunctate. Elytra a little longer and broader than the thorax, about as long as broad, with a sutural row of 7, a discal of 6, a humeral of 9 punctures and traces of a sub-humeral row, the rest of the disc extremely finely and very sparingly, the reflexed margins less finely and much more closely punctured. Abdomen shining gradually narrowed from base to apex, scarcely iridescent, very finely and closely punctured at the bases of the segments, more sparingly towards the apices and with a fine yellow, not close pubescence.

♂. Sixth ventral segment with smooth triangular impression

extending nearly the whole length of the segment medially, the base of it with a triangular excision.

Mussorie and Chakrata districts, 6000 to 9000 feet above the sea. Under dead leaves at the margins of streams.

Acylophorus beesoni n. sp.

Black, shining, the margins of the thorax and posterior margins of the elytra more or less narrowly rufescent. Abdomen gradually pointed, iridescent, the posterior margins of the 7th and 8th segments sometimes obscurely rufescent. Antennae with the 1st joint reddish, 2nd and 3rd infuscate, the following testaceous. Legs reddish. Length 9·75 mm.

Very near *A. furcatus* Motsch.,* but larger and more robust with longer, lighter antennae, the head and temples a little longer, the abdomen less pointed, the elytra rather less roughly punctured, the abdomen rather more closely punctured. Head narrow, oval; temples shorter than eyes, closely and finely punctured, disc near border of the eye with a large puncture. Antennae with the 2nd and 3rd joints of equal length, 4th to 7th a little longer than broad, gradually decreasing in length, 8th and 9th about as long as broad, 10th and 11th transverse. Thorax transverse, widest behind, sides moderately rounded and narrowed in front, posterior angles completely effaced, disc bipunctate, occasionally with a puncture behind the anterior angle and another between this and the discal puncture; against the lateral margin towards the front with a large puncture. Scutellum finely asperately punctured. Elytra about as broad as the thorax, slightly transverse, closely, finely, asperately punctured and finely grey pubescent. Abdomen finely and rather closely punctured and pubescent. Anal styles black.

Mussorie district; Kaligad. In damp places near streams.

Anchocerus monticola n.sp.

Black, shining, head subquadrate, eyes small, temples long, scarcely rounded, very finely and closely punctured, front with 2 large approximate punctures, juxta-ocular punctures wanting, 2 others on either side before the base, very finely and rather closely punctured except on the disc which is very sparingly punctured. Antennae entirely testaceous, 2nd joint much longer than 3rd, 4th to 8th all a little longer than broad, gradually decreasing in length, 9th and

* The examples of this insect found on the lower slopes of the Himalayas are usually of darker colour than the type form, the thorax and elytra being blacker and also the anal styles.

10th slightly transverse, 11th as long as the preceding. Thorax slightly transverse, narrowed in front, the sides feebly, the posterior angles broadly rounded; disc bipunctate, externally adjacent to the margin and towards the front with 2 others, puncturation finer and more sparing than on the head. Scutellum very finely, closely punctured. Elytra as long as, but scarcely as wide as the thorax, square, moderately finely, moderately closely, simply punctured, very shortly pubescent. Abdomen gradually narrowed from base to apex, more finely and more closely punctured than the elytra, not iridescent; 7th and 8th segments narrowly obscurely rufescent behind and more sparingly punctured. Styles black. Legs reddish. Length 8·75 to 13 mm. (excluding the styles).

♂. Sixth ventral segment broadly rounded.

Differs from *A. birmanus* Fauv., in the entirely testaceous antennae, smaller eyes, non-rugulose elytra, black anal styles and the ♂ characters.

Mussorie district; Kaligad. In damp leaves near the streams.

(*To be continued.*)

XIV. *A Revision of some old Types of* Formicidae.

By W. C. Crawley, B.A., F.R.M.S.

[Read June 3rd, 1925.]

With Thirteen Text-Figures.

The interesting and primitive Ponerine genus *Myrmecia* has long been in need of revision, and myrmecologists may be well content that this task is being undertaken by Mr. J. Clark, who in his dual capacity of systematist and field-naturalist is well equipped for the task. Some time ago Mr. Clark asked me for information relating to Smith's types of this genus, and I re-described and made drawings of these types for his use.

At the time when Smith was describing Hymenoptera, descriptions were not expected to be of the length and detail that is now considered necessary, and Smith, even for his period, erred on the side of brevity. Realising to what extent foreign myrmecologists, who had been unable to see the types for themselves, had been misled by these inadequate descriptions, I conceived the idea of revising all Smith's types of the Formicidae. This was some twelve years ago, and the war prevented the idea from being carried out, but a few were re-described in 1922.

The genus *Myrmecia* is of particular interest as it is confined to Australia and Tasmania, with the exception of one species from New Caledonia, and it is almost distinctive enough to form a sub-family of its own. (Emery, in the "Genera Insectorum," says that morphologically this genus approaches most nearly to the root of the family of Ants). In view of the probability of Mr. Clark's proposed work not appearing for some time yet, I have thought it worth while to publish the following revision of Smith's types.

Other types of Smith re-described by me are: *Odontomachus ruficeps* and *cephalotes* and *Aphaenogaster longiceps*, in the Annals and Magazine of Natural History (ser. 9, vol. ix, Ap. 1922).

I have omitted all but the most essential characters in the descriptions of *Myrmecia*.

At the request of several foreign myrmecologists, I con-

clude this paper with drawings and an accompanying description of the much-discussed type of *Camponotus maculatus* Fabricius. This venerable insect has been ably described by Donisthorpe (Ent. Rec., xxvii, p. 10, 1915), and Arnold (Ann. S.A. Mus. xiv, part v. pp. 621–4, 1922) in his description of *maculatus* has given some notes on the type specimen, but neither of these authors gave figures to

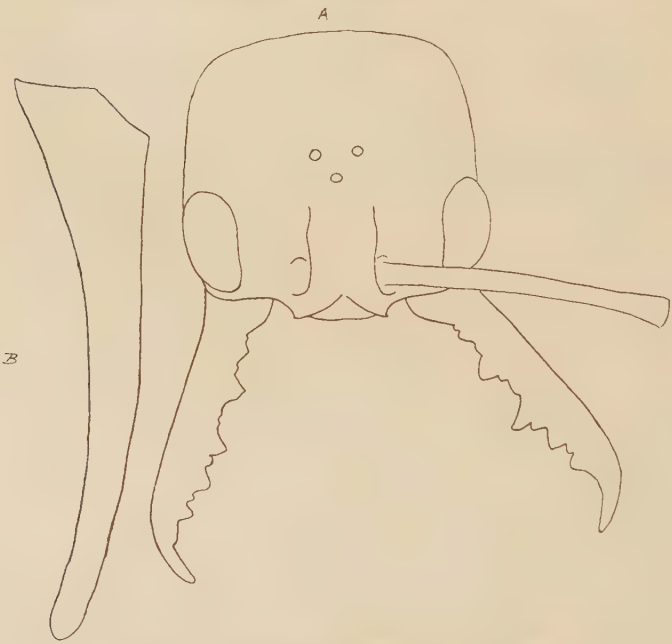


Fig. 1.—*Myrmecia crudelis* Sm., ♀ type.
A = Head. B = Mandible in profile.

show the disposition of the abdominal colouring. I have added a description for the sake of completeness.

Myrmecia crudelis Smith.

♀ Type. Fig. 1. (Cat. Hym. Brit. Mus., vi, p. 147, 1858.)

♀. Length (without mandibles) 20 mm. Mandibles 4·3 mm.

Dark reddish-brown, nearly black; mandibles, antennae and tarsi castaneous.

Pilosity fine, fairly abundant, dark. Pubescence grey, sparse.

Whole insect robust. Head broader than long, as wide behind as in front, the sides parallel, the occipital angles rounded, the border nearly straight. Mandibles robust, the outer border straight or feebly convex. Pronotum broad. Stalk of petiole shorter than the node, the latter being twice as long, slightly broader than long, broadest behind; in profile it is higher in front than behind, the

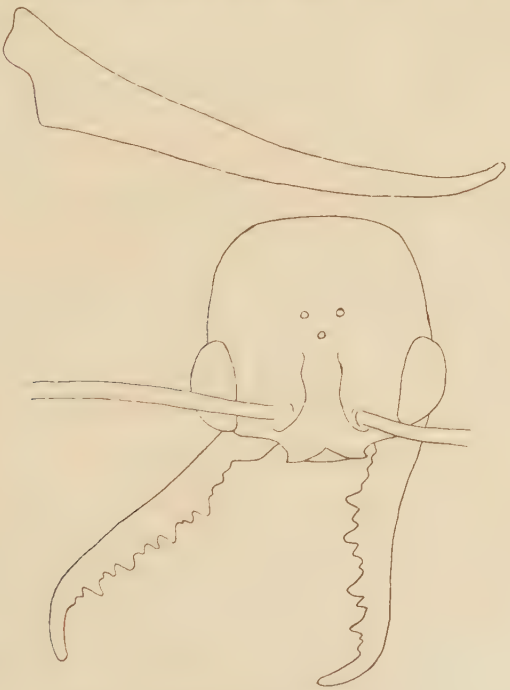


Fig. 2.—*Myrmecia vindex* Sm., ☿ type.

node rising from the stalk in an oblique angle. Underneath in front is a small tooth. Second node broader than long, more than $1\frac{1}{3}$ as broad as the first.

Head coarsely longitudinally rugose, the rugae diverging outwards towards the back of the head. Pronotum with transverse arched striae, rest of thorax and first node transversely striate. Second node and gaster smooth and shining, with microscopic reticulation.

It being uncertain which specimen is the type ☿, I have only described the ♀ of this species.

Myrmecia vindex Smith.

Type. British Museum. Label, "Mr. Moore, West Australia." Fig. 2. (Cat., p. 144.)

☿. Length (without mandibles) 19 mm. Mandibles 4 mm.

Ferruginous; mandibles yellow, teeth edged with black, gaster dark brown, nearly black.

Pilosity rather short, pubescence grey, sparse, principally on under surface of gaster.

Head very slightly, if at all, broader than long, broadest behind eyes, narrowing somewhat rapidly behind, occipital border slightly concave. Mandibles long and thin, the outer border concave. Pronotum anteriorly with a distinct longitudinal impressed line in centre.

Petiole with a long stalk, as long as the rest of the segment; node evenly rounded above, rising gradually from the stalk; beneath is a small acute tooth in front.

Head longitudinally rugose, the rugae more irregular and broken on the vertex and occiput. Pronotum with transverse arched striae, almost straight at base and narrowly arched near apex. Rest of thorax evenly transversely striate. First node with transverse arched striae, second and gaster smooth and shining.

Myrmecia simillima Smith.

Type. British Museum. Fig. 3. (Cat., p. 144.)

☿. Length (without mandibles) 18·5 mm. Mandibles 4·2 mm.

Dark brown, nearly black; mandibles, clypeus, antennae and tarsi ferruginous, rest of legs brown, gaster black. Teeth of mandibles edged with black.

There is a moderately long grey-white pilosity, also a thin grey pubescence over most of body.

Head broader than long, hardly, if at all, narrowing behind the eyes; occipital border straight.

Thorax robust; stalk of petiole slightly shorter than the rest of the segment; in profile the node is slightly higher in front, rising somewhat abruptly, but in an oblique angle, from the stalk. There is a small tooth beneath in front. From above the node is oval, narrower in front, the top somewhat flat. Postpetiole short and broad, 1½ as broad as the first.

Head coarsely longitudinally rugose, the rugae diverging outwards towards the occiput. The rugae are not clean-cut, but wrinkled, and there is a dense ground-reticulation between them.

Neck transversely and pronotum longitudinally striate, the striae on the pronotum diverging outwards towards the base. Rest of thorax transversely striate, the epinotum coarsely so. There is a ground reticulation, similar to that on the head, on the thorax and first node. Apex of node encircled with striae, the rest irregularly transversely rugose. Postpetiole and gaster smooth and shining, with a very faint microscopical reticulation.

Fig. 3.—Myrmecia similima Sm., ♀ type.

Myrmecia pyriformis Smith.

Type. British Museum. Fig. 4. (Cat., p. 144.)

♀. **Length 20·5 mm. Mandibles 4 mm.**

Dark brown; mandibles, antennae and legs ferruginous.

Body with a very short yellowish or grey pilosity. There is a thin grey pubescence over most of the body, principally on gaster and second node.

Head broader than long (3·7 mm. broad by 3·3 long). Posterior angles rather square, less rounded than in *crudelis* Sm., though the head is not so broad behind. Outer border of mandibles concave, teeth large. First node as broad as long, very broad behind and

narrowing rapidly in front. Stalk of node very short, the node being 2½ times as long as the stalk. In profile the node rises abruptly in front, more so than in *crudelis*.

Head coarsely longitudinally rugose. Pronotum with moderately arched striae. First node superficially transversely striate, and with one or two punctures in addition. Second node and gaster smooth and shining, both covered with minute points. There is a reticulate ground-sculpture over the whole body.

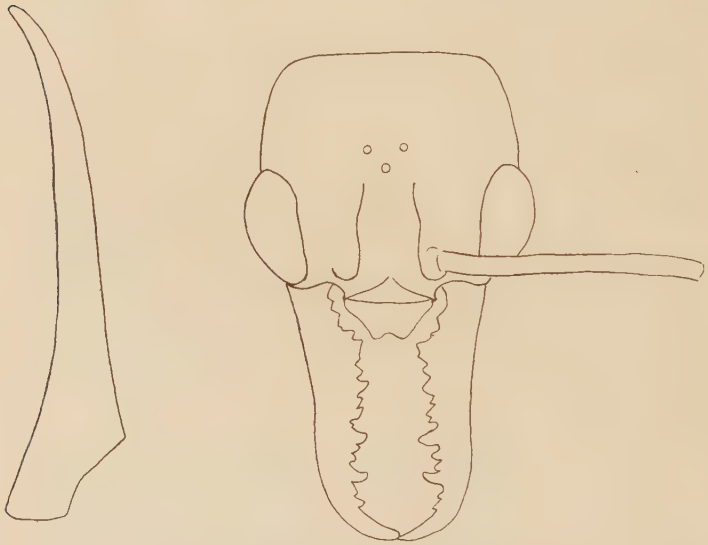


Fig. 4.—*Myrmecia pyriformis* Sm., ☿ type.

Myrmecia sanguinea Smith.

Type. Tasmania. Label, "Smith coll. Pres. by Mrs. Farren White." Fig. 5. (Cat., p. 148.)

☿. Length (without mandibles) 12·5 mm. Mandibles 2·6 mm. (measured from the upper surface of base).

Red, gaster black, coxae paler red, scapes rather darker. Mandibles same colour as head.

Whole body, including legs, with shortish erect hairs. Scapes pubescent, with a few recumbent hairs at apex. There is a thin grey pubescence on body, most abundant on gaster.

Head 2·4 mm. long by 2·6 mm. wide behind eyes, narrower behind, posterior angles moderately rounded. Exterior border of mandibles concave in the middle.

Mandibles with 5 large teeth, not counting the apical; between the apical tooth and the first large one are two smaller teeth; between the 1st and 2nd large teeth are also two smaller ones; between the 2nd and 3rd large teeth are 3 smaller ones, and between the 3rd and 4th one smaller one. The 4th is followed by the 5th large tooth, which is the largest. Beyond the 5th is one medium tooth. The first node seen from above is widest behind the middle, the posterior angles rounded. From the widest point it narrows rapidly to a blunt point at apex. The stalk of the node is less than half as long as the node.

Head irregularly longitudinally striate, but not rugose. Beyond the eyes the striae diverge outwards. At the occiput, which is

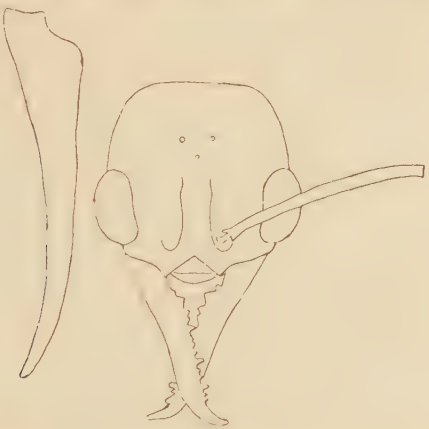


Fig. 5.—*Myrmecia sanguinea* Sm., ☿ type.

mostly smooth, are several short transverse striae. Pronotum with regular arched striae, those in the centre nearly straight. Rest of thorax transversely striate.

First node with a few semi-obsolete striae across the anterior portion, otherwise smooth and shining. Second node and gaster smooth and shining. There is a faint ground-reticulation between the striae on the head, but none on the thorax.

Myrmecia tarsata Smith.

☿ Type. British Museum. Label, "Hunter River." Fig. 6. (Cat., p. 145.)

☿. Length (without mandibles) 21 mm. Mandibles 4 mm.

Black; mandibles yellow, castaneous at apices, teeth edged with

dark brown, antennae and tarsi pale castaneous, legs dark brown, gaster and second node dark metallic blue.

Pilosity short and sparse. There is a fairly abundant grey pubescence.

Head considerably broader than long, and slightly shorter than mandibles. Occipital border slightly concave. Mandibles with 4 large blunt teeth (excluding the apical), and one or two small blunt teeth between. Outer border feebly concave.

Thorax massive. Petiole short and thick, from above broadly

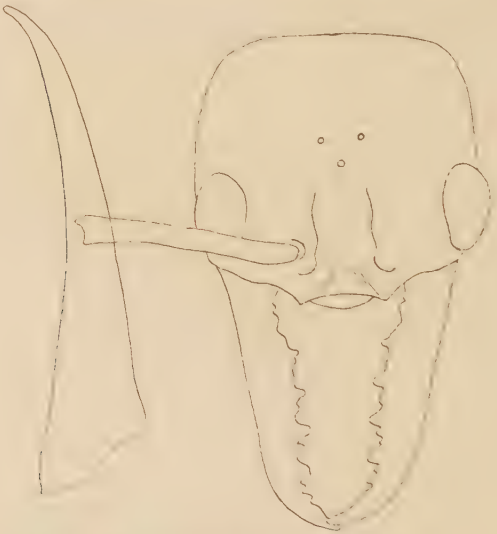


Fig. 6.—*Myrmecia tarsata* Sm., ☿ type.

oval, in profile vertical in front, sloping behind, the top feebly convex. Stalk very short, less than half the rest of node. The usual small tooth beneath in front. Postpetiole very broad, one-third broader than long, and 1½ as broad as petiole. Legs thick.

Mandibles with plentiful small punctures. Head coarsely longitudinally rugose, the lines wrinkled. Neck transversely rugose, the rest of pronotum with a central line and rugae diverging from it towards the base of the segment. Rest of thorax irregularly transversely rugose. First node irregularly rugose, more or less longitudinally. Between the rugae of head, thorax and node the integument is finely reticulate and shining. Postpetiole and gaster smooth and shining with a microscopical puncturation, much

base on the gaster. In addition the postpetiole has a few piligerous points.

Myrmecia nigrocincta Smith.

Type British Museum Label, "Australia." Fig. 7. (Cat., p. 147.)

♀. Length (without mandibles) 11 mm. Mandibles 2·6 mm.
Head, mesothorax and gaster, dark brown, almost black; mandibles

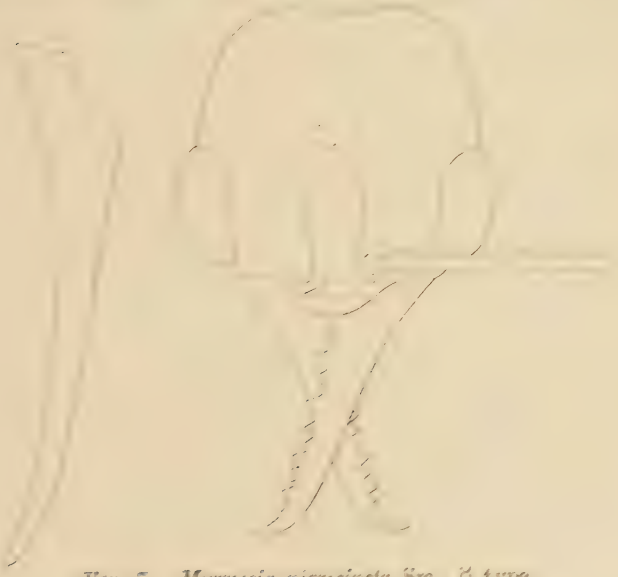


Fig. 7.—Myrmecia nigrocincta Sm., ♀ type.

pale ferruginous; pronotum, epinotum and petiole ferruginous, postpetiole dark brown with a ferruginous patch on each side in front, and one transversely across the base; the dark brown parts and anterior tibiæ paler.

Erect pilosity brown, short, coarse here, long on gaster. Pubescence grey, principally on gaster.

Head as broad as long, widest just behind the eyes, whence it narrows regularly. Occipital angles rounded. Eyes convex one-quarter of its length beyond the occipital border. Mandibles long and narrow, the outer border slightly concave (see fig.).

Pronotum with a longitudinal impressed line. Epinotum from above $\frac{1}{3}$ as long as broad, the apex rounded. Down the centre is

an impressed line. First node in profile rounded, slightly higher behind, the stalk short, slightly more than half as long as the node. From above the node is elongate-oval; the second node is twice as broad, slightly broader than long, narrow in front.

Mandibles microscopically longitudinally striolate, with a few points near the apex. Head very finely longitudinally striate, with a dense ground-reticulation. Pronotum with arched striae, those in the centre behind the middle being very close together. Mesonotum with faint transverse striae. Epinotum with coarser striae. The thorax has a ground-sculpture less dense than that on the head. Petiole and gaster smooth, the first node having a microscopical reticulation, the second and gaster microscopical points.

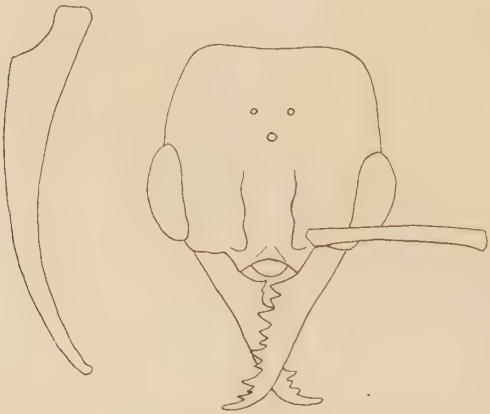


Fig. 8.—*Myrmecia picta* Sm., ♀ type.

Myrmecia picta Smith.

Type. British Museum. Label, "Adelaide." Fig. 8. (Cat., p. 146.)

♀. Length (without mandibles) 9·8 to 10 mm. (The specimen has been pinned and has broken at the pin, and in consequence it is not possible to measure accurately.) Mandibles 1·6; head 1·7 mm.

Dark brown; mandibles, clypeus, frontal carinae and the space between them up to the level of the centre of eyes, and a patch (continued from the clypeus) reaching obliquely from the antennal insertions to nearly half-way up the eye, castaneous yellow; teeth of mandibles ferruginous; antennae castaneous; coxae ferruginous, forelegs the colour of the antennae, the hinder pairs darker, the

femora of the hindmost pair dark ferruginous; petiole dark ferruginous.

Pilosity fine and short, pubescence thin and grey, fairly abundant on upper surface of gaster.

Head very slightly broader than long, broadest at posterior margin of eyes, narrowing considerably to occiput. Occipital border concave. First node from above subglobose, in profile with a short stalk only half the length of the rest of node, the top rounded, higher in front, where it rises somewhat abruptly, sloping behind. Postpetiole broad and short, considerably broader than long, 1½ as broad as first node. Posterior femora considerably swollen for their basal half.

Mandibles with no punctures except the row of piligerous punctures along the line of the teeth. The rest finely reticulate. Head with a fine ground-reticulation, and longitudinal rugae beginning halfway down the eyes and frontal carinae and continuing to the occiput in irregular and broken lines. Whole of thorax irregularly wrinkled, the direction of the rugae indefinite; first node irregularly and circularly rugose. Postpetiole and gaster covered with microscopic points. Legs reticulate. Thorax and first node have in addition a ground-reticulation.

Myrmecia pilosula Smith.

Type. British Museum. Label, "pilosula Smith. Type." Fig. 9. (Cat., p. 146.)

♀. Length (without mandibles) 10 mm. Mandibles 2·2 mm.

Black; mandibles pale castaneous yellow, antennae, tibiae, tarsi and anterior half of anterior femora, ferruginous, rest of legs dark brown.

Pilosity very short and scanty. Pubescence grey, most abundant on postpetiole and gaster.

Mandibles slender, the outer border concave (see fig.). Head almost square, slightly broader than long, the sides converging very slightly behind the eyes, the occipital angles abruptly rounded, the border widely and somewhat deeply concave. The scapes just pass the occipital border.

Epinotum from above nearly twice as long as broad, the anterior border rather broad and transverse. First node in profile abruptly concave in front, rounded behind, the top convex, higher in front. Seen from above it is slightly broader than long, almost transverse in front, rounded behind, the sides very convex. Down the centre is a small elevated ridge. Postpetiole nearly 1½ as broad as long, rather more than 1½ as broad as the first node, narrowed in front.

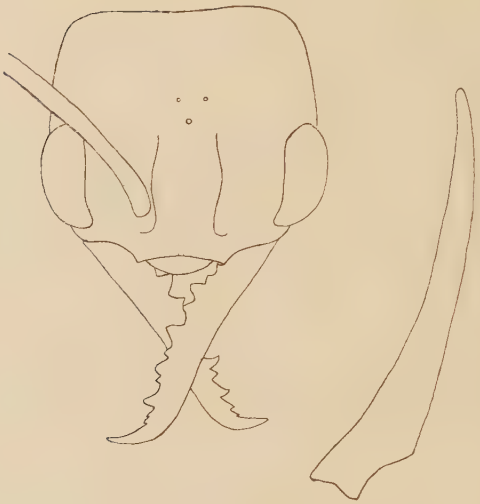


Fig. 9.—*Myrmecia pilosula* Sm., ☿ type.

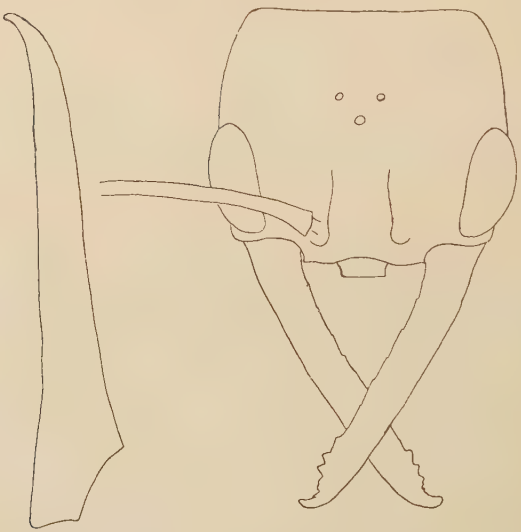


Fig. 10.—*Myrmecia mandibularis* Sm., ☿ type.

Dull; mandibles shining with abundant small punctures. Head, thorax and petiole with a dense fine ground-reticulation, and in addition the head is finely longitudinally striate, the pronotum has longitudinal striae diverging towards the base, the mesonotum is longitudinally striate, the first part of base of epinotum longitudinally rugose, the rest transversely striate, and the first node has rugae encircling the sides, and the top is superficially rugose. Postpetiole and gaster covered with microscopical points.

Myrmecia mandibularis Smith.

Type. British Museum. Fig. 10. (Cat., p. 145.)

♀. Length (without mandibles) 11 mm. Mandibles 2·9 mm.

Black; mandibles, antennae and legs dark red-brown, tarsi somewhat paler.

Pilosity short and dark, scanty on head and thorax, longer and more abundant on pedicel. Gaster with a dense coat of ferruginous pubescence.

Head broader than long, only slightly broader in front than behind, the occipital angles square, the border widely concave. For mandibles and clypeus see fig. The scape barely passes the occipital border.

Epinotum broad, 1½ as long as broad, the apex broad and rounded. First node in profile cubic, vertical in front, slightly rounded behind, the upper surface feebly convex. Seen from above it is as broad as long, broadest just past the centre, contracting rapidly behind, and narrowing gradually in front to form a transverse anterior border. There is the usual small tooth in front beneath. Postpetiole almost 1½ as broad as long, more than 1½ as broad as the petiole, not at all narrowed anteriorly into a neck.

Shining; mandibles with a few elongate punctures. Head very evenly longitudinally striate, the striae nearly straight, under surface of head mostly smooth. Pro- and mesonotum similarly but rather more strongly striate. The anterior part of the base of epinotum longitudinally rugose, the remainder and the declivity transversely rugose. First node longitudinally rugose, second node irregularly and shallowly longitudinally rugose, some of the rugae taking the form of elongate punctures.

There is no ground-reticulation on body or head.

Myrmecia piliventris Smith.

Type. British Museum. Label, "Australia. F. Smith coll. Type." Fig. 11. (Cat., p. 146.)

☿. Length (without mandibles) 12 mm. Mandibles 2·6 mm.

Black; mandibles and legs very dark red-brown, tarsi and articulations lighter.

Pilosity fairly abundant, dark brown, most abundant under head. There is a slight grey pubescence over parts of the head, thorax and legs. Postpetiole with a thin coat of pale golden pubescence, gaster with a similar but thicker coat.

Head rectangular, broader than long, widest behind the eyes, whence the sides converge extremely slightly to the occipital border,

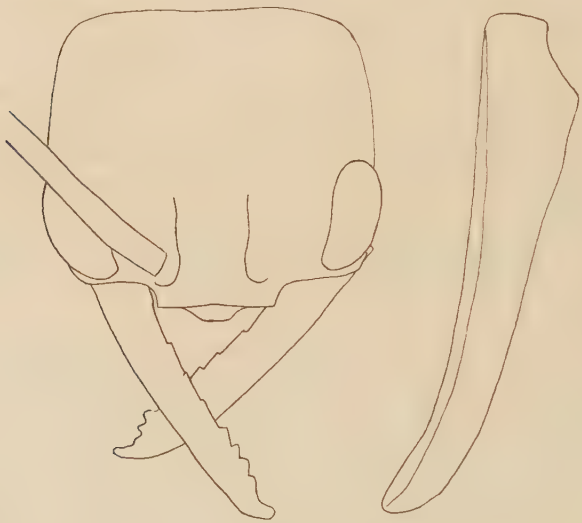


Fig. 11.—*Myrmecia piliventris* Sm., ☿ type.

which is feebly and widely concave; the occipital angles are somewhat square. The scape just reaches the occiput. The mandibles are much shorter and straighter proportionately than in *mandibularis*, also somewhat thicker (see fig.).

Thorax somewhat stout. Epinotum from above broad, broadest behind, the sides converging evenly to a blunt and rounded apex; nearly 1¼ longer than broad. First node in profile cubic, vertical in front and behind, the top almost straight. Seen from above it is almost exactly as broad as long, the sides evenly convex, the anterior border transverse, narrower than the equally transverse posterior border. It is slightly wider in front and not so wide behind proportionately as in *mandibularis*. Postpetiole broad and

rounded, about 1⅓ as broad as long, slightly more than 1½ as broad as first node, similar in shape to that of *mandibularis*.

Shining, but duller than *mandibularis*. Mandibles with a few indeterminate striae at base, which become lines of longitudinal punctures further on.

Head strongly and evenly longitudinally striate, more coarsely than in *mandibularis*. At the occipital angles the striae tend to become reticulate. The under surface of head is reticulate-striate.

Sculpture of pro- and mesonotum similar to that on head but coarser. Anterior part of base of epinotum longitudinally wrinkled, the rest transversely so. First node longitudinally rugose, the postpetiole and gaster densely covered with microscopical points hidden by the pubescence.

The sculpture of the whole insect is altogether coarser than in *mandibularis*.

Cerapachys antennatus Smith.

Jour. Proc. Linn. Soc. Lond. Zool., II, p. 74 (1857). ♀ Type. Borneo (Sarawak), Fig. 12.

Length 7·3 mm. with mandibles. (Smith gives 3½ lines, approximately the same.)

Black; mandibles, clypeus, antennae, legs, pygidium, sting and borders of segments of gaster, ferruginous. The coxae and a patch near the apex of scapes are slightly darker.

Body, legs and antennae with moderately long scattered yellowish-white hairs. Pubescence nil, except on funiculi, tibiae and tarsi.

Head slightly longer than broad, broadest at eyes, broader behind than in front, the sides moderately convex from the occiput to the eyes; from the eyes to the anterior border the sides narrow, at first keeping a straight line, then becoming concave just before the base of mandibles. Occipital border widely and shallowly concave and marginate, the margination continuing under the head. This sharp border gives the occipital angles the appearance of turning outwards. Vertex very convex. On each side between the eyes and the genal carinae the surface of the head is depressed. Mandibles broad, triangular, bent at base, the terminal borders with minute blunt teeth. Gula with a minute blunt tooth at each side. Clypeus short and straight. Frontal carinae high anteriorly, vertical, almost parallel; seen from the front not quite twice as long as their greatest width; between them in front is a small median tooth. Posteriorly they descend rapidly and converge, running parallel

for a short distance but not actually meeting. Frontal groove represented by a few longitudinal striae terminated by 3 punctures in the form of a triangle. Cheeks with a carina, not very prominent, reaching beyond the termination of the frontal carinae. The outer edge is moderately straight for about two-thirds of its length, then curving inwards and forming a blunt oblique-angled projection.

The scapes swell rapidly from base to apex, where they are twice as wide as at base; they reach as far as the middle of the eyes. The latter are placed just behind the middle of sides. All joints of the funiculus except the apical are broader than long, increasing in breadth to the apical, which is equal to more than the preceding 4 joints; joints 7 to 10 equal in length, 6 slightly shorter, the preceding ones extremely short.

Thorax narrower than the head, not quite twice as long as broad, slightly constricted at the meso-epinotal suture, behind which it attains its greatest breadth, which is slightly more than at the pronotum. Promesonotum longer than broad, the anterior border straight and marginate, the margination continuing down the side and beneath, forming a somewhat prominent inferior angle. Sides of pronotum more or less straight. Mesoepinotal suture distinct, showing as a slight impression in the back of thorax in profile, which is otherwise almost straight. Base of epinotum from above broader than long, the sides somewhat convex, the declivity about half as long, slightly concave, and marginate all round.

Petiole from above narrower than the epinotum, slightly longer than broad, very slightly broader behind, the sides feebly convex; in profile it is convex above, slightly higher in front where it is truncate and marginate; beneath is a flat process bearing 2 teeth. Postpetiole considerably broader and longer than the petiole, only slightly longer than broad, more than $\frac{1}{3}$ broader behind than in front, the sides convex, the anterior border with a broad crenulate margination forming sharp lateral angles. In profile it is convex above, higher behind, strongly convex below, the anterior border vertical right through the segment. First segment of gaster longer and broader than postpetiole. Pygidium truncate, with a raised lateral border spinulose along its whole length. At the side of the epinotum is a strong oblique carina just below the spiracle. Middle and hinder tibiae longer than the metatarsi.

Smooth and shining; mandibles shining with a few irregular punctures. Cheeks longitudinally grooved; carinae roughened; head between the eyes and frontal carinae irregularly longitudinally striate. Head, thorax and petiole with a few small scattered circular punctures, postpetiole with similar punctures but smaller, and gaster with even smaller punctures.

Smith says "smooth and shining." There is no trace of longitudinal groves on the petiole, as in *sulcinodis* Em., and *jacobsoni* For., nor of any confluent punctures as stated by Wheeler ("The Ants of Borneo," Bull. Mus. Comp. Zool., lxiii, 3, p. 45, 1919) in his description of a *Cerapachys* which he took to be *antennatus* Smith. Wheeler's species, judging from the description, also differs from *antennatus* in having the thorax longer, the postpetiole shorter and narrower and without crenulations on its anterior border, the posterior tibiae not longer than the metatarsi, the mandibles opaque, and in other smaller details. I propose the name *wheeleri* for this species.

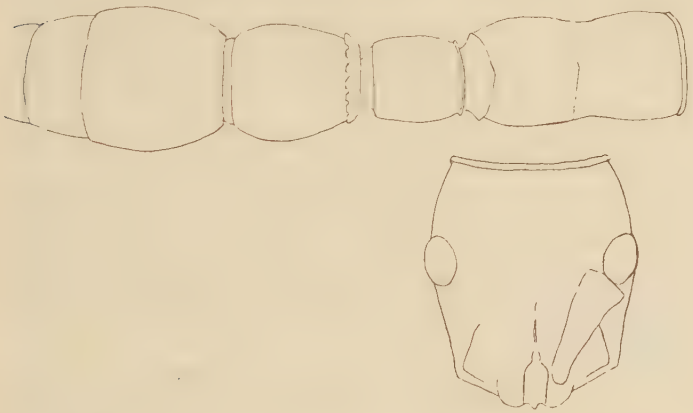


Fig. 12.—*Cerapachys antennatus* Sm., ☿ type.

Judging from the description and figures, the ♀ described by Emery in Ann. Mus. Stor. Nat. Genova, xxv, p. 445 (1887), is probably not the ♀ of *C. antennatus* Smith.

Side by side with the type of *C. antennatus* Smith in the Oxford collection is another *Cerapachys* from Borneo, which corresponds in many points to the species described by Wheeler. I give below some notes on this specimen, but without seeing Wheeler's specimen I hesitate to name it.

Cerapachys labelled "Borneo" only, Oxford Museum.

☿. Length 6·1 mm. Black, with a slight bluish tinge on head and thorax.

Structure very similar to Wheeler's species, but differs in the following points: Sides of head convex from occiput to just beyond

the eyes, from which point they are straight. Eyes placed distinctly behind centre of sides. No impression on vertex. The gula teeth cannot be seen, probably owing to the method of mounting. The frontal carinae, though similar, actually converge. There is a short frontal groove. The lateral anterior angles of the genal carinae are more prominent than in *antennatus*.

The scapes reach to the top of the eyes. The antennal joints are more globular, and the apical equals the preceding four joints.

Thorax at pronotum less broad than at epinotum. In profile it is more convex in front, and the suture shows. Epinotum and petiole as in Wheeler's species, but the tooth beneath the latter double as in *antennatus*. The postpetiole is similar but differs from Wheeler's in the anterior margination, which is not clean-cut, but on the other hand not distinctly crenulate as in *antennatus*. The carina on the side of epinotum less prominent than in *antennatus*. The tibiae of posterior pair are slightly shorter than the metatarsi; of the median pair longer.

Mandibles shining, sparsely punctate. Head shining with very sparse points, mostly on vertex; thorax with similar points.

Petiole longitudinally sulcate, the lateral sulci broken up by large punctures.

It also differs from *antennatus* in being much less punctured generally, and the petiole is narrower in profile, the postpetiole broader behind and the sides less rounded. The thorax is narrower, especially behind.

Cerapachys MANNI sp. nov.

♀. Length 11 mm. Black; mandibles, frontal carinae, cheeks, antennae, extremities of coxae and femora, the tibiae and tarsi, a large patch on the sides of the postpetiole and the first segment of gaster, the borders of segments of gaster, and the pygidium, ferruginous. Wings yellow-brown, nervures dark brown.

Pilosity over whole body moderately long, golden-brown. Genal carinae pubescent.

Head two-thirds as broad as long, broadest at eyes, sides from eyes to base of mandibles nearly straight and feebly convergent, from eyes to occiput slightly convex, the occipital border concave and margined. Eyes placed just behind the middle of sides of head. Mandibles large, with a long terminal border, longer than the basal border, edentate. Frontal carinae parallel for first three-quarters, then rapidly converging and merging into a short ridge. In front there is a blunt triangular projection but no point or tooth as in *antennatus*. The scapes, which are more than twice as wide at apex as at base,

reach to the back of the eyes. All joints of funiculus broader than long, except the apical, the first two very short. The apical equals the 4 preceding. The outer border of the genal carinae almost straight, the lower angle not very prominent and the upper one consisting of a globular bead. The hind tibia is a fraction shorter and the middle tibia slightly longer than the metatarsus.

Thorax massive, slightly broader at the insertion of the wings than the head. The anterior border of pronotum is margined. The feebly concave declivity of epinotum is slightly longer than the base, the latter is more than twice as broad as long, and slightly convex. The declivity is bluntly bordered.

Petiole seen from above, broader than long, almost rectangular; in profile slightly higher in front where it is vertical and bluntly bordered. Low down on each side is a sharp longitudinal ridge. Postpetiole nearly twice as long as petiole and one-third broader, transverse in front, broadest behind, the sides feebly convex. The first segment of gaster similarly shaped but larger.

Pygidium broad, the apex semicircularly rounded, the border armed with small upright teeth.

Shining; mandibles coarsely and irregularly grooved, the grooves broken by irregular punctures. Head between frontal carinae and genal carinae roughened, then follows a smooth patch with one or two small punctures reaching up to the level of the upper third of the eyes; the remainder of the head is covered with close round punctures except between the ocelli. The thorax similarly punctured, but more sparsely on the scutum, and the scutellum and the centre of base of epinotum are almost smooth. Declivity microscopically reticulate. The upper surface of the petiole has a broad, smooth and shining space reaching from the anterior border for three-quarters of the segment, and half as wide as the whole node; the sides are coarsely rugose-punctate. Postpetiole and gaster with sparse and small punctures. The pygidium closely and finely punctate, except a narrow central strip which is smooth. Scapes closely punctate.

A single ♀ from Serapai (Korintji), Sumatra. (E. Jacobson leg., No. 1272.) Type W.C.C. coll.

I dedicate this species to my friend Dr. W. M. Mann.

Cerapachys jacobsoni For. s.sp. SUMATRENSIS s.sp. nov.

☿. Length 7·1 mm. Black, with a faint bluish tint on parts of head and thorax; mandibles, antennae, cheeks, clypeus, legs and borders of segments of gaster, ferruginous.

Pilosity fairly long, sparse, yellowish-white.

Mandibles as in the type, but terminal border rather longer in proportion. Clypeus similar, also frontal carinae, which have a small tooth between them in front. Genal carinae with a somewhat more prominent anterior lateral angle. Scapes slightly longer, joints of the funiculus less transverse, the apical longer proportionately.

Head distinctly broader and sides more convex. Eyes placed further back.

Thorax considerably stouter. Pedicel and gaster similar except for size.

Posterior tibiae equal in length to the metatarsi, as in *jacobsoni*.

Puncturation of head, thorax, postpetiole and gaster similar. Sculpture of petiole similar, *i.e.* there are two strong central ridges, unbroken, with a deep and smooth sulcus between them and one on each side. The ridges bordering these latter sulci are broken; between them and the well-defined ridge along the base of each side of the segment, the surface is covered with broken longitudinal ridges with deep irregular pits between. Scapes sparsely punctured.

1 ☿. Gunung Dempu, 1916, 1400 metres. (E. Jacobson leg. No. 1207.) W.C.C. Coll.

Much larger than *jacobsoni*. Two cotypes of the latter in my collection measure 5·5 mm. (Forel gives 6·5 mm.). The ferruginous portions are much less bright. The coloration, and the shape of the head as well as the much stouter proportions generally make the new subspecies easily distinguished. The petiole is longer than in *sulcinodis* Em., from which both *jacobsoni* and the subspecies differ in the presence of a meso-epinotal suture and the contraction of the thorax at that point.

C. jacobsoni For. is described in the Zool. Jahrb., xxxvi (1913), from Java.

♀. Length 7·3 mm. Colour similar to that of the ♀, but the anterior femora partly dark brown.

Pilosity more abundant, yellow.

Petiole shorter, and the two lateral sulci broken by rows of large punctures. Postpetiole and gaster proportionately shorter and broader than in the ☿. Otherwise, except for sexual differences, similar to the ☿.

Wings pale brown, the nervures darker.

2 ♀♀. Gunung Dempu, 1916, 1400 metres (E. Jacobson leg. No. 1261.) Type, W.C.C. Coll.

Camponotus maculatus Fab. (*Formica maculatus* Fab.)

Type. Fig. 13.

4. Length 12 mm. Head (without mandibles) 4 mm., greatest width (at occiput) 3·8 mm., scape 3·5 mm. (funiculi missing), middle femur 3·5 mm., middle tibia 3 mm., middle tarsus 3·3 mm. (the posterior legs are missing). Gaster 4 mm. long by 3 mm. wide.

Head and mandibles brown-black, scape brown-black except a small part at each extremity, funiculus dark yellow, Pronotum and upper surface of thorax dark reddish-brown, lighter than the head. Rest of thorax, the scale and femora, dirty yellow, tibiae and tarsi brown.

Fig. 13.—Gaster of *Camponotus maculatus* Fab., ♀ type. Showing disposition of marking.

A. View from above. B. 1st segment seen from in front. C. Profile.

Gaster dark brown with the exception of the yellow patches and borders of the segments. For disposition of the yellow patches see fig. The patches are not quite so well-defined as they appear in the drawing.

Scapes without erect hairs, but covered with a fine close-lying pubescence. Posterior tibiae with only a few bristles on the under surface. There are 4 long stiff hairs on the pronotum, a few on the scale and on each segment of the gaster, yellow.

Mandibles with 7 teeth. Clypeus carinate.

The scape extends a distance equal to about twice its width beyond the occipital border.

Tibiae flattened, not prismatic.

The whole body is very finely reticulate, the legs and gaster more finely than the rest.

XV. *Teratological Specimens in the Hope Department of Zoology in the Oxford University Museum.* By E. A. Cockayne, D.M., F.R.C.P.

[Read June 3rd, 1925.]

Plates XLIII–XLV.

I am indebted to Professor E. B. Poulton for permission to publish the following account. The collection contains seven examples of Coleoptera with complete or partial reduplication of a leg and two with the same condition affecting an antenna. All conform more or less closely with the law propounded by Bateson in his "Materials for the Study of Variation." In this work he brought forward evidence to prove that abnormalities of this kind are caused by an injury to an appendage at a point proximal to the reduplication, and subsequent experiments by Chapman and others have confirmed the correctness of this view. Of the present series only one shows definite signs of injury.

In addition there is an example of a double limb not following Bateson's Law and six insects with other structural defects.

Popilia ligulata Ohs.

Male. (*Rutelidae, Col.*) Ulugoro Mt., 1.iii. 1921 (Proc. Zool. Soc. 1923, lxv, p. 1028).

The right mesothoracic leg has a very large coxa, which becomes broader distally and shows by the ridges on its surface that it is a fused triple one. Posteriorly a trochanter articulates with it, and anteriorly there is another larger trochanter with a groove partially separating it into two parts. From the posterior trochanter arises a kinked and twisted femur, a well-formed tibia and a tarsus, of which the last three segments have been broken off. Two femora spring from the anterior trochanter. At the extreme base they are firmly united by smooth chitin, and they are also, I think, ankylosed with the trochanter. Each has an almost perfect tibia and tarsus. The anterior of these femora is curved with the convexity in front, and the posterior one is bent downwards and backwards upon itself near the base, and more distally is curved with the convexity behind. All parts of these three legs are reduced in size.

The elaborate arrangement of hairs and spines on the legs of this

species makes it quite clear, that the posterior leg is the original one and that the middle and anterior ones are supernumerary and in secondary symmetry with one another. In other words, the middle leg is a mirror image of the posterior or original leg and the two extra ones are mirror images of one another. Pl. XLIII, fig. 1.

The following two specimens are described by Bateson, pp. 496 and 508.

Pyrodes speciosus Oliv.

Male. (*Prionidae, Col.*)

The coxa of the left mesothoracic leg is enlarged and encroaches a little beyond the mid-line on to the right side of the abdomen. Outside and slightly posterior to it but enclosed in the same socket lies a second coxa, which is a mirror image of the other. From the inner one arise a trochanter, femur, tibia and tarsus normal in structure and only slightly smaller than those of the right side. From the outer coxa, which is to be regarded as the supernumerary one, springs a trochanter bearing two femora. They are rotated slightly downwards and backwards, so that the first lies with its dorsal surface pointing forwards. It has a perfect tibia and tarsus, both a little smaller than the normal. The whole leg is a mirror image of the leg which arises from the inner coxa, and in structure is like a leg of the opposite side of the body. The other extra femur, which lies behind and above, is a mirror image of the first extra femur, but is rotated so that its ventral surface approaches the ventral surface of the other one. The tibia arising from it is rather short and thin and twisted, and has a tarsus with only three of the proximal segments present. The two extra legs are mirror images of one another. Pl. XLIII, fig. 2.

Alaus sordidus Westw.

? sex. (*Elateridae, Col.*) Ceylon.

A complete dorsal view of this insect, the type of the species, is given by Westwood in his "Cabinet of Oriental Entomology," Plate 35, fig. 9, and a brief description is appended. The right mesothoracic leg has a normal coxa, but the trochanter, at first of the usual width, rapidly expands and gives rise to a triple femur, united in the proximal half but separated distally, the separation being a little more complete between the anterior and middle parts. The anterior part may be regarded as the original limb and the two posterior ones as the supernumerary ones. From each part of the triple femur arise a tibia and a tarsus; those from the anterior part are normal, those from the middle one are perfect except that the

tarsus has the anterior claw aborted and represented by a tiny chitinous knob; the tibia of the posterior part is perfect, but its tarsus has only two segments. The first supernumerary or middle limb is a mirror image of the normal or anterior one, and the second supernumerary or posterior limb is a mirror image of the middle or first supernumerary one. The relative positions of the three legs depart from any shown in Bateson's diagram probably owing to distortion of the trochanter. Pl. XLIII, fig. 3.

Omphra rufipes Klug.

Female (*Carabidae, Helluonini, Col.*) (3440), 1052. Ceylon, about 2000 ft., Kandy, above reservoir. Capt. Feb. 1908 and presented 1908 by G. B. Longstaff (Proc. Ent. Soc. Lond. 1909, p. lxxi).

The coxa of the right mesothoracic leg is slightly enlarged, the femur is greatly thickened distally and shows a single ventral groove posteriorly, which may be regarded as that of the original limb, and a double groove anteriorly. From the posterior part arises a normal tibia provided with a tarsus which lacks the terminal segment. From the anterior part springs a tibia which is of the usual width at its origin, but which rapidly enlarges and bifurcates in its distal third. The tip of the anterior of the two partially fused extra tibiae is provided with the usual two spines (calcaria), and its structure is like that of a normal right tibia. The tip of the posterior extra tibia appears to be like that of a left tibia, but only the anterior spine is present and the chitin of the area from which the posterior spine should arise is rough and irregular. Each of the extra tibiae gives origin to a tarsus with the four terminal segments broken off. The two extra tibiae are mirror images of one another, and the posterior one is a mirror image of the normal tibia lying behind it. Pl. XLIV, fig. 1.

Phyllotreta diademata Foudr.

Male. (*Halticidae, Phytophaga, Col.*) Kirtlington Park, Oxford. J. Collins, 5.ix.1915.

The first segment of the tarsus of the left metathoracic leg is normal, but the second segment is much dilated. From the ventral part of this arise a bilobed third segment and closely united fourth and fifth segments, all normal in structure, the last segment ending in two claws pointing downwards. This part appears to be a continuation of the normal tarsus. A little to the inner side and above this there is another bilobed third segment giving origin to a fourth segment of the usual width. The fifth segment is much increased in its dorso-ventral diameter, and the ventral part ends in two claws

pointing upwards, which are mirror images of those on the normal fifth tarsal segment. The dorsal part is shorter and ends in a single claw pointing downwards, a mirror image of the inner claw of the ventral part of the extra tarsus.

Presumably the thickened second tarsal segment is a triple one produced by fusion between the ventral surfaces of a pair of extra segments and between the dorsal surface of the original segment and the dorsal surface of the nearer of the two extra segments. The last three segments of the extra tarsus are probably double ones with fused ventral surfaces. Vertical reduplication such as this in a dorsal or ventral direction is much rarer than horizontal reduplication in an anterior or posterior direction. Pl. XLIV, fig. 2.

Mylabris pertinax Péring.

Probably female.

The left antenna has the structure normal until the fourth joint from the end is reached. This is dilated distally and finally bifurcates. The inner half bears three normal terminal joints, and may be regarded as the true continuation of the antenna. The outer half gives origin to a joint wider than usual with a small projection on its inner aspect and with two articulating surfaces at its distal end. From each of these springs an independent antennal tip, with two joints both rather smaller than normal. These are extra parts. The inner one points downwards and the outer one inwards and downwards. There is no doubt that they are mirror images of one another, and that the inner one is a mirror image of the last two joints of the original termination, although they are rotated inwards to a small extent. Pl. XLIV, fig. 3.

Photuris trilineata Say.

Female. (*Lampyridae, Col.*)

Of the right antenna the fifth segment from the end is constricted and twisted in the middle, and lacks some of the usual hairs. The segment distal to it is about double the normal width, irregular in outline with a depression near the middle, pale and almost hairless. The third segment from the end, also pale and almost hairless, is still thicker at its distal end and has a longitudinal groove running nearly all its length. The outer part extends beyond the inner and gives rise to a penultimate and terminal segment, both of normal build. From the inner part a penultimate segment of double the usual thickness arises, and this in turn gives origin to a terminal segment of the usual width but rather short. The absence of hairs and the distorted ill-formed segments make it impossible to prove

that the third segment from the end is a fused triple one, and that the thicker of the two penultimate segments is a fused double supernumerary one, but this is probable. There is strong evidence that an injury caused this abnormality. Pl. XLIV, fig. 4.

Tenthredo colon Klug.

Female. (*Hymenopt.*)

The coxa of the left mesothoracic leg is situated considerably in front of the usual position and is very long and constricted in the centre. The anterior part forms a prominence, much smaller than a normal coxa, from which arises a trochanter with a small thin femur, a small twisted tibia and a small perfect tarsus. The posterior part forms a larger prominence, not quite so large as a normal coxa, and gives origin to a rather small trochanter, a femur sharply bent in its proximal third, a tibia curved and slightly reduced in size and a tarsus perfect but not quite so large as the normal. The anterior and posterior aspects of the corresponding limb are so much alike, that I am unable to determine whether both these limbs are in structure like left legs or not. Part of the mesothoracic sternite is broken away, and the two terminal segments of the tarsus of the right mesothoracic leg are missing.

This is an example of a double limb not conforming with Bateson's Law. There is nothing to support the view that either of these left mesothoracic legs is a fused double leg. In fact, both are abnormally slender. Pl. XLIV, fig. 5.

This specimen is described by Bateson, who says that, of all the cases in insects, it is one of the nearest to the condition of true duplicity.

Heterorrhina nigritarsis West.

Male. (*Cetoniidae, Col.*)

The dorsal plates of the prothorax have never fused and form two separate portions, each roughly quadrilateral, with their inner angles approximated near the middle line. The plate on the left side has a depression near the centre, and the one on the right has three depressions and is considerably the smaller. The abnormality is due to an arrest of development, and the depressions in this and other similar specimens suggest that pressure on the thorax may have produced it. Pl. XLIV, fig. 6.

This particular condition is so rare that I give the following references to other recorded cases. Frivaldsky figures an example of complete separation of the pronotum in *Brachinus crepitans* L. (Term. fusetek. 1889, xii, pp. 72–78,

Pl. III, fig. 20). Tornier describes and figures complete division of the pronotum in *Melolontha vulgaris* Fabr., *Bubas bison* L., and *Oryctes nasicornis* L., and partial division in *Xylotrupes minos* Kolbe (Arch. f. Entwickmech. Leipzig, 1900, ix, pp. 501–562, Taf. XX, figs. 7, 9, 11, 10). Hustache figures an example of complete failure of union of the pronotum in *Otiorrhynchus moestus* Gyll. (Bull. Soc. ent. de France, 1923, p. 141), and Gadeau de Kerville figures another in *Geotrupes stercorarius* L., in which the left portion is very small (*ibid.*, p. 231). Bellevoye figures one in *Melolontha vulgaris* L. (C. R. Assoc. Franc. avanc. scienc. 36 session Reims, 1907, p. 645, fig. 15). Arendsen Hein found a number of examples in *Tenebrio molitor* L., and mentions the frequency of dints and deep grooves. The anomaly did not reappear even in the F. 2 generation (Journ. of Genetics, 1920, pp. 231–232, fig. 4, and Ent. Mitteilungen, 1924, xiii, p. 169, fig.).

Anchomenus oblongus F.

(*Carabidae*, *Col.*). J. Collins, Water Eaton, Oxon., 26.i.1924.

This remarkable specimen has on the right metathoracic leg a complete extra part, which one may describe as a tarso-tibia, interposed between the tibia and the tarsus. The femur, tibia and tarsus of this limb appear to be normal in size and structure, and the extra part is equal in length to the tarsus. The proximal portion of the extra part closely resembles the first segment of a tarsus and articulates by means of perfect joints with the tibia and with the distal portion. The latter shows partial sub-division into segments. Its proximal portion is in structure very like the second segment of a tarsus and, although no actual joint is present, it is almost cut off from the more distal portion, which has transverse lines indicating an attempt at further segmentation. The structure of the piece which represents the third and fourth segments is quite abnormal, but is more like tarsus than tibia. The terminal segment is more clearly demarcated and resembles the distal end of a tibia in many respects. The large calcaria are well developed and six spines are present corresponding to the comb or pecten so characteristic of this part of a tibia, but they are shorter and in less perfect alignment than those of the tibia. Pl. XLV.

I do not know of any other case, in which an extra part has been found interpolated between the normal ones, and can offer no explanation of its origin.

There is no sign of injury, and the fact that the normal parts are of full size and the extra part itself is as long as the tarsus is against the view that it originated from an injury. It is an almost universal rule that after destruction or damage to a part the regenerated part is smaller than normal, or, if extra parts are formed, each of these is smaller than normal, although the whole mass of regenerated tissue may be greater than that of a single normal part. Nevertheless, one must bear in mind that injury is far the commonest cause of structural abnormalities, and it may have led to the production of this example of monstrous growth.

Melolontha vulgaris L.

Female. Edward Evans, Summertown, 1863.

The left metathoracic leg is very greatly reduced in size, but every part is present and perfectly formed. The comparative measurements of the two hind-legs are as follows: femur, left 4 mm., right 7 mm.; tibia, left 2 mm., right 6·25 mm.; tarsus, left 2·5 mm., right 6 mm.; total length, left 8·5 mm., right 19·25 mm.

Probably the limb was accidentally amputated and regenerated. Similar results have been produced experimentally by Newport, Gadeau de Kerville, Chapman and others, but it is unusual to find such perfect regeneration when the limb as a whole is so much reduced in size. Several similar examples in various species of Coleoptera have been captured and recorded and figured during the last twenty years.

Apis mellifica L.

Male.

The tarsus of the right mesothoracic leg is small and distorted, and that of the left also shows a similar but slighter imperfection of development. The tibia and proximal segment of the tarsus of the right metathoracic leg are greatly distorted, widened and thinly chitinised and the last four segments of the tarsus are absent. A very similar condition is present in the left metathoracic leg, but a very diminutive and crumpled second tarsal segment is present. The defect is probably due to abnormal environmental conditions during the larval or pupal stage.

Donisthorpe describes and figures a similar but less extreme case in *Formica rufibarbis* F. (Ent. Record, 1922, xxxiv, p. 83, Pl. II, fig. 4).

Ceuthorrhynchus trimaculatus F.

(*Rhyncophora Col.*) Tubney, 14.vii.1923. Musk-thistle (*Carduus nutans* L.).

The distal extremity of the tibia of the right prothoracic leg is malformed. It terminates in a pointed process and on the anterior surface is a lateral protuberance, with which the tarsus articulates. The first and second segments of the tarsus are considerably shortened. The tarsus projects forwards at right angles to the long axis of the tibia.

Lucanus cervus L.

Male.

The left mandible, and the first and third segments of the left palpus are bent sharply outwards and backwards. One of the middle joints of the left antenna is constricted and the distal end of the tibia, and the third and fifth tarsal segments of the left prothoracic leg are kinked and bent back. These deformities must be due to pressure during the pupal stage.

Explanation of Plates

PLATE XLIII.

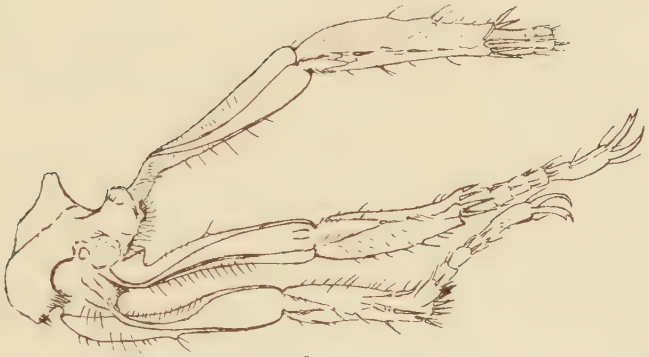
Fig. 1. *Popilia ligulata* Ohs. Ventral aspect of right mesothoracic leg.
2. *Pyrodes speciosus* Oliv. Ventral aspect of left mesothoracic leg.
3. *Alaus sordidus* Westw. Ventral aspect of right mesothoracic leg.

PLATE XLIV.

Fig. 1. *Omphra rufipes* Klug. Ventral view showing normal left and abnormal right mesothoracic leg.
2. *Phyllotreta diademata* Foudr. Tarsus of left metathoracic leg.
3. *Mylabris pertinax* Péring. Terminal part of left antenna.
4. *Photuris trilineata* Say. Terminal part of right antenna.
5. *Tenthredo colon* Klug. Ventral view showing two mesothoracic legs on the left side.
6. *Heterorrhina nigritarsis* West., with complete separation of prothoracic plates.

PLATE XLV.

Fig. 1. *Anchomenus oblongus* F. Right metathoracic leg with a complete extra part, a tarso-tibia.
2. The tarso-tibia under higher magnification.



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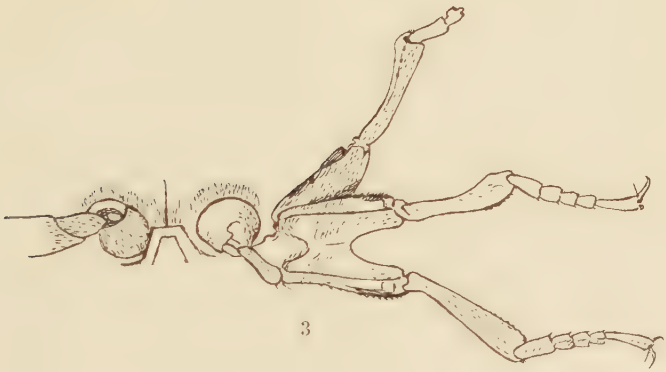

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TERATOLOGICAL SPECIMENS.

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XVI. *Notes on* Neuroptera *from Palestine, including a description of a new species of* Myrmeleonidae.

By Kenneth J. Morton.

[Read June 3rd, 1925.]

Plate XLVI.

As indicated in the paper on the *Odonata* of Palestine which appeared in these Transactions for 1921 (pp. 25–44), I also received from Dr. Buxton a good many true *Neuroptera*, notes on which, including the description of a new species of *Myrmeleonidae*, are now given. That the collection of these insects is less representative of the fauna of the country as a whole than was that of the *Odonata*, is almost certain, and may have been due in part to the fact that in my communications to Dr. Buxton more encouragement was given to the collecting of dragon-flies. The localities frequented by the latter may also have been more closely associated with other lines of research in which he was engaged. The almost entire absence of the herbage-frequenting and arboreal aphidivorous *Chrysopidae* and *Hemerobiidae*, which are usually abundant in most European localities in coniferous and mixed woodland, may not have been altogether accidental but may rather point to a scarcity of suitable conditions. The only species which appears to have occurred commonly is *Chrysopa vulgaris*, an insect which in Eastern countries seems to abound, although in Britain it is by no means one of the commonest species. *Myrmeleonidae*, which are terrestrial in their early stages, form the bulk of the collection. The sands and gravel of the coastal zone and the limestone of the hill country evidently suit the larvae of these insects, which seem to flourish in or near regions which are more or less desert in character.

Dr. Buxton in a valuable report on "Applied Entomology of Palestine" (Bull. Ent. Research, xiv, pt. 3, pp. 289–340, March 1924) has given an interesting general account of the country, its climate and fauna, with a map which shows the position of most of the localities mentioned in the following notes. He regards Palestine as part of a faun-

istic "peninsula," the base of which is Asiatic Turkey, the stem Syria and the extremity Palestine and parts of Transjordania, the other boundaries of the third mentioned being the Mediterranean on the west and the desert on the east and south, the fauna of the "peninsula" being for the most part palaearctic but also including certain desert types, some of them of Ethiopian affinities.

In dealing with the *Odonata* I mentioned that along with many characteristic European species there was a considerable admixture of African forms and one or two of more Eastern type. I was also able to make comparison with the dragon-flies occurring in the adjacent countries, but at present it is scarcely practicable to attempt a similar comparison with regard to the *Neuroptera*. The material available is still insufficient. It may be noted, however, that the majority of the *Myrmeleonidae* are species having a wide range in the Mediterranean region. Of the other representatives of the same family, *Formicaleo laticollis* is known at present only from Syria and Palestine, and the two species of *Macronemurus* have so far been found only in the same region. The genus *Solter* is an interesting one; it was originally described from a species from Portugal, but other forms have since been found in the Sahara, Egypt, Cyprus and Syria. Of the other families, *Nemoptera aegyptiaca*, said by Buxton to be common in Palestine, has been recorded also from Syria and Egypt; hitherto it appears to have been rare in collections. *Bubopsis hamatus*, the only Ascalaphid received, has been recorded from Turkey, South Russia, Asia Minor and Egypt.

For the wing-photographs which are reproduced on Pl. XLVI. I am much indebted to my friend Mr. Martin E. Mosely.

MYRMELEONIDAE.

Palpares libelluloides Linné.

Beisan, ♂, 30.vii.22; ♀, 15.vi.22.

Out of a fairly long series of *Palpares*, these are the only specimens which can with certainty be referred to this species. In size (hind-wing, ♂, 54 mm.; ♀, 57 mm.), the dark lines on the abdomen and the small sub-basal spots on the hind-wings, they may be regarded as quite typical.

The distinctive characters of *libelluloides* and *hispanus* were discussed by McLachlan in his paper, "*Neuroptera*

collected by Mr. J. J. Walker, R.N., on both sides of the Straits of Gibraltar" (Ent. Monthly Mag., xxv, pp. 346–7, 1889), where he remarks: "I have before me nearly thirty examples of *libelluloides*, ranging from the South of France eastward to Syria (the latter would be the var. *aeschnoides* Illig.). Also 14 examples of *hispanus*, all from Spain and Marocco. From the *ensemble* of characters *hispanus* appears to differ from *libelluloides* in its broader and shorter wings, on which the dark markings are more pronounced, and the irrorations on the anterior more numerous. On the posterior the isolated rounded subbasal spot is, on the whole, much larger (in *libelluloides* it is sometimes reduced to a mere point; it is the largest in the small form known as *aeschnoides*). Furthermore, the abdomen in *hispanus* appears to me shorter than in *libelluloides*, especially in the ♂; and in *hispanus* it is *broadly* and *transversely banded* with black, whereas in *libelluloides* it has black *longitudinal lines*, nevertheless, the two styles of markings may be considered modifications of one. This black transverse banding I hold as of great importance in separating the two, and it is constant and conspicuous, except in examples that have become discoloured by decomposition."

Palpares hispanus Hagen.

Nazareth, ♀, 12.v.21, stony hillsides; Zikron Jacob, coastal zone, ♂, 17.v.21; Khedeira, ♂, 30.v.21; Akka, ♀♀, 8–9.vi.21, common among thistles and herbage: sea-level; Bitter, ♂♀, 22.v.22; Jerusalem, ♂♂♀♀.

The males in the above series agree very well with McLachlan's definition of *hispanus*. They are smaller than Andalusian and Algerian specimens in my collection, and they vary much in size (length of hind-wing: Zikron Jacob, 40 mm.; Khedeira, 43 mm.; Bitter, 34 mm.; Jerusalem, 40–43 mm.). The females have the abdomen more or less discoloured and the markings thereon nearly obliterated. They are accordingly less satisfactory than the males, especially two rather large examples (h.-w. 46–50 mm.) from Akka, from which locality no males are before me, but none of them has the same facies as the Beisan female mentioned under *P. libelluloides*. I submitted a pair from Jerusalem to Herr Petersen and he agrees that they are *P. hispanus*, the male a typical one and the female,

which is discoloured, hardly to be mistaken if compared with a typical and fully coloured specimen. It is probable that the transverse black markings on the abdomen may be less pronounced than in the males.

I have not seen any examples that can be considered representative of the form from Syria to which McLachlan refers as *aeschnoides* Illig., in the above-mentioned paper. A suspicion may exist from his reference to the relatively larger sub-basal spot in the hind-wings and smaller size of *aeschnoides* when compared with the typical form of *libelluloides*, that he was dealing with discoloured females of what I have called here *hispanus*, but on the whole I think this may be dismissed as unlikely; his remarks give the impression that he had gone into the matter very thoroughly: there is just a faint note of uncertainty in his admission that the two styles of abdominal markings may be considered modifications of one! On the other hand, what is this Eastern *aeschnoides*? *P. libelluloides* exists in Palestine in typical form; large typically marked specimens are also in my collection from Amasia, Asia Minor (Manissadjian), and Kazvin, N.W. Persia (Buxton), while a very large male from Van (Manissadjian) has the abdominal and wing-markings of *hispanus*.

Father Navás (Revista Montserratina, Barcelona, 1911, p. 3) records *P. papilionoides* Klug from Jerusalem, but this in all probability is the result of an error in identification. Herr Petersen has kindly sent to me for inspection photographs of Klug's types of *papilionoides* in the Berlin Museum, and these represent something different from any species of *Palpares* that I have seen from Palestine.

Formicaleo laticollis Navás.

Revue Russe d'Entom., xiii, 1913, No. 2, p. 278 (sep. 8).
Haifa, 13.v.21.

The type (Geneva Mus.) is from Syria. I have no doubt as to the identification, the markings of the thorax and wings so far as figured by Navás agreeing, the only slight difference being in the median marking of the pronotum, which in Navás's figure shows a pale line only in the anterior part, whereas in the Haifa specimen the pale line is continued faintly for the whole length of the marking. The prothorax is also relatively longer in the latter, but if a long series of say *Formicaleo tetragrammicus* is examined, considerable variation in this respect will be found to exist,

depending apparently on whether or not the posterior and little chitinised part of the pronotum has in drying become withdrawn under the anterior part of the mesothorax.

The wings of this species are figured on Pl. XLVI, fig. 3. (Nat. length of h.-w. 26½ mm.)

Neuroleon arenarius Navás.

Near Samakh, Galilee, 13.v.21; Haifa, 25.vi. 21.

This small species has a wide distribution in the Mediterranean region. It has been recorded from Spain, the South of France, Italy, Greece and Asia Minor.

Nelees imbecillus Stein.

Hebron, 6.vii.23.

Known from Greece and elsewhere on the eastern part of the Mediterranean region. It is closely allied to *N. nemausiensis* of the South of France and Spain.

Creoleon plumbeus Oliv.

Akka, 8.10.vi.21; Jerusalem, 29.v., 8.vii.22; Kakoun, 10.vi.22; Wadi el Hawarit, 12–13.vi.22; Beisan, 15.vi.22; Benjaminah and Nahr es Zerka, v.23; Amman, Transjordania, 2500 ft., 29.viii.21.

A common and wide-spread species: known from the whole Mediterranean region and extending to Persia.

Creoleon aegyptiacus Ramb.

Khedeira, 30.v.21; Athlit, 21.v.21.

Range not definitely known to me, but probably more restricted than that of the preceding species. Has been recorded from Corsica by Navás, who says it is spread over the north of Africa.

Macronemurus linearis Klug.

Athlit, 23.v.21; Khedeira, 30.v.21; Akka, 8.vi.21.

A fair series, but including only two males, one unfortunately damaged.

For the determination of this species I am indebted to Herr Esben Petersen, who has been able to compare an example which I sent to him, with photographs in his possession taken from Klug's types. A description of the Palestine specimens follows :—

Yellowish with heavy blackish markings. Head above almost entirely dark excepting the occipital margin and a spot near the eyes,

the dark colour being continued between the base of the antennae and forming an inverted somewhat cordate marking in front, where it is separated from the base of the antennae by a yellow stripe on either side; front otherwise pale excepting sometimes a trace of a dark median line terminating as a virgule on the labrum. Antennae dark brown with very fine paler annulations.

Pronotum with a broad median line divided in its anterior part by a fine yellow line; and on either side a narrower dark sub-lateral line running from the posterior margin to the anterior transverse sulcus. Mesonotum: praescutum dark on anterior margin, the dark coloration being continued as a median line of varying width along nearly the whole length of the mesonotum, covering the greater part of the praescutum, narrower on the scutum and still narrower on the scutellum; scutum also with dark lateral streaks. Metanotum with somewhat similar markings: praescutum with broadish dark margins; scutum with dark median and lateral lines, and scutellum with a rather broad dark median marking not reaching the posterior margin. Pleura of thorax mostly black but interrupted with yellow; underside mostly black, joining the black in pleura.

Abdomen with a broad black dorsal line, narrow lateral lines and black underneath. Appendages of male about the length of the two last segments, pale yellow at the extreme base, then slightly fuscescent and clothed rather densely with rather long black hairs.

Legs: yellowish with black spines and hairs; a dark streak at base of coxae; tarsi and apex of tibiae annulated with brown, anterior tibiae sometimes slightly fuscescent. Short and strong; hind tibia slightly shorter than femur and about same length as tarsus; 1st tarsal joint as long as 2 and 3 together, 5 as long as the 4 preceding joints; spurs longer than two first joints reaching about middle of 3 in middle legs and slightly shorter in posterior legs. On the back of the posterior femora of the ♂, a series of long curved hairs diminishing in length towards the apex.

Wings: hyaline, costa dark grey; in fore-wings principal nervures yellowish-white with blackish streaks where the pale transverse nervules (sometimes blackish at their bases) join them; costal nervules mostly blackish in their anterior half; nervules in apical field, sub-apical gradate series and base of the apical forks also blackish; hind-wings with the nervures somewhat similarly marked but Rs mostly black as are also the basal parts of its sectors; M^{1a} almost entirely pale, and some of the costal veinlets more extensively blackish. Pterostigma yellow. Fore- and hind-wings of nearly equal length; apical field in both with gradate cross-veins. Rs in fore-wing arising about 2 cells beyond level of fork of Cu; angle

between Cu^{1a} and Cu^{1p} acute; 2nd sector of Cu^{1a} at or slightly beyond extreme end of Cu^{1p}. In radial field before origin of Rs, 7 veinlets; in field between R and Rs, 9–11 veinlets before pterostigma and 1 beyond same before sub-apical gradate series; Rs emitting 7–8 sectors.

Length of hind-wing, ♂, 20 mm.; ♀, 20–24 mm. Length of abdomen (exclus. apps. of ♂), ♂ 15 mm.; ♀, 16–18 mm.

This and the following species differ from *M. appendiculatus* and *M. bilineatus* in the shorter abdomen of the ♂ and in the presence of the series of curved hairs on the posterior femora in that sex, and agree in these respects with *M. elegantulus* McL. from Algeria, and with *Geyria saharica* Petersen (Archiv für Naturgeschichte, 1918, p. 147).

Macronemurus delicatulus n. sp.

Wadi Kelt, 20.v.22, 16.v. 23; Tel Arad, So. Palestine, 22.v.23.

Stramineous with dark brown or blackish markings. Head with a broad transverse band behind the antennae, the dark colour being continued narrowly between and under the base of the antennae, forming in front an inverted Y; two small transverse dark markings on vertex. Antennae with basal joint pale, otherwise with dark annulations; underside of club paler.

Thorax above predominantly stramineous. Pronotum with dark sub-lateral lines broadest posteriorly running from the posterior margin to anterior sulcus. Mesonotum: praescutum having its anterior margin and two posterior dots, dark; scutum, dark broad lateral markings becoming broken up posteriorly; scutellum anteriorly with narrow dark margins. Metanotum: praescutum with dark lateral margins anteriorly; scutum with dark lateral lines; scutellum with two anterior dots. Thoracic pleura mostly dark but partially interrupted and tending to form double lines on meso- and meta-thorax. Mesothorax, dark beneath, this colour joining with the dark on pleura.

Abdomen dark above, paler at base of segments, the last three or four segments becoming paler dorsally and dark on the sides which otherwise are pale; underside nearly entirely dark. Appendages in one ♂ about same length as two last segments, in the other ♂ slightly shorter; pale yellowish with pale hairs mixed with blackish ones especially at the apex.

Legs pale, coxae with a dark basal streak, tarsal joints scarcely darker; hairs and spines mostly dark, a few weak pale spines on

femora and tibiae. Tibiae slightly shorter than femora. First tarsal joint as long as 2 and 3 together; 5 almost as long as the four preceding joints; spurs longer than the two first joints. A series of curved hairs on posterior femora, diminishing in length towards the apex.

Wings hyaline with a whitish or yellowish tinge; neuration entirely pale yellowish excepting the costa and the costal nervules for part of their length, which are darker. Pterostigma yellow. Hind-wings rather shorter than fore-wings. Apical field with gradate cross-nervules in both fore- and hind-wings in the ♀, but only in fore-wings in the ♂. In fore-wing Rs arising 2½ to 3 cells beyond level of fork of Cu. The angle between Cu^{1a} and Cu^{1p} sub-acute; second sector of Cu^{1a} apparently rising normally about level of end of Cu^{1p}. In Radial field before origin of Rs, 7 veinlets; in field between R and Rs, 8 (7) before stigma and one beyond same before sub-apical gradate series; Rs emitting 8 sectors.

Length of fore-wing, ♂, 20–23¼ mm.; ♀, 22–24½ mm.
hind-wing, ♂, 19–22 mm.; ♀, 21–23¾ mm.

Length of abdomen (exclus. of ♂ apps.), ♂ 17–18½ mm.; ♀, 17–18 mm.

Solter ledereri Navás.

Mem. Real Acad. de Ciencias y Artes, x. No. 9, p. 169, sep. p. 37, 1912.

Jerusalem, 16.viii.21.

The species of this interesting genus seem to be closely allied, and it remains to be determined, from more extensive material than is at present available, to what extent the differences in the various described forms may be due to individual variation or even to degrees of maturity. In the general character of the wing-markings the Jerusalem insect has some resemblance to *S. liber* from San Fiel, Portugal, a specimen of which I received many years ago from Father Navás, but in the latter the markings are much more decided. In the Palestine specimen the thorax is testaceous and the markings are broken up into series of completely isolated dots, while in *liber* the markings are more extensive and confluent giving the thorax a much darker appearance, and the same may be said of the abdomen.

I submitted a photograph of the wings to Father Navás and at the same time gave him some indications of the markings on the thorax, and he has kindly informed me that after comparing the photograph with a ♀ of *S. ledereri* from Beirut he finds it almost identical, and does not doubt that

it is the same species, some little differences such as the presence of fewer veinlets in the apical field of the fore-wing being probably individual.

Wings of *S. ledereri*, Pl. XLVI, fig. 2 (length of h.-w. 33 mm.), and for comparison wings of *S. liber*, fig. 1 (length of h.-w. 29 mm.).

Myrmecaelurus trigrammus Pallas.

Akka, 8, 9. 28.vi.21; Kakoun, 10.vi.22; Wadi el Hawaris, 11–13.vi. 25.vi.22; Beisan, 15.vi.22; Benjaminah, vi.23.

Another common and widespread species in the Mediterranean region. Known also from South Russia, Caucusus and Persia.

Morter hyalinus Oliv.

Haifa, 22.vi.21, 15.vii.21; near Ismailia (in train), 30.x.21.

Mediterranean region, Sahara, Caucusus, Arabia, Mesopotamia.

Superficially, from the pale colour of its wings, bears some resemblance to the species described in this paper as *Macronemurus delicatulus*.

ASCALAPHIDAE.

Bubopsis hamata Klug.

Khedeira, 31.v.21, 1♂.

NEMOPTERIDAE.

Nemoptera aegyptiaca Ramb.

Akka, 8.vi.21; Kakoun, 10.vi.22; Wadi el Hawaris, 11–13.vi.22; Huldah, 22.v.23.

CHRYSOPIDAE.

Chrysopa vulgaris Schneider.

Jerusalem, 4.v.21; 19.v., 25.x.22; 12.iv.23; Jericho, 29.i.22; Haifa, 24–26.iv, 5, 7, 21–24.v., 3.vi.21; 26.iii.22; Athlit, 22.v.21; Tabagha, 6.iv.22.

Chrysopa flavifrons nigropunctata Ed. Pictet.

Nebi Samuel, 5.vi.22.

One example which seems to belong to this form. According to Navás it has a wide distribution in Spain.

Explanation of Plate XLVI.

Fig. 1. *Solter liber.*
2. *Solter ledereri.*
3. *Formicaleo laticollis.*

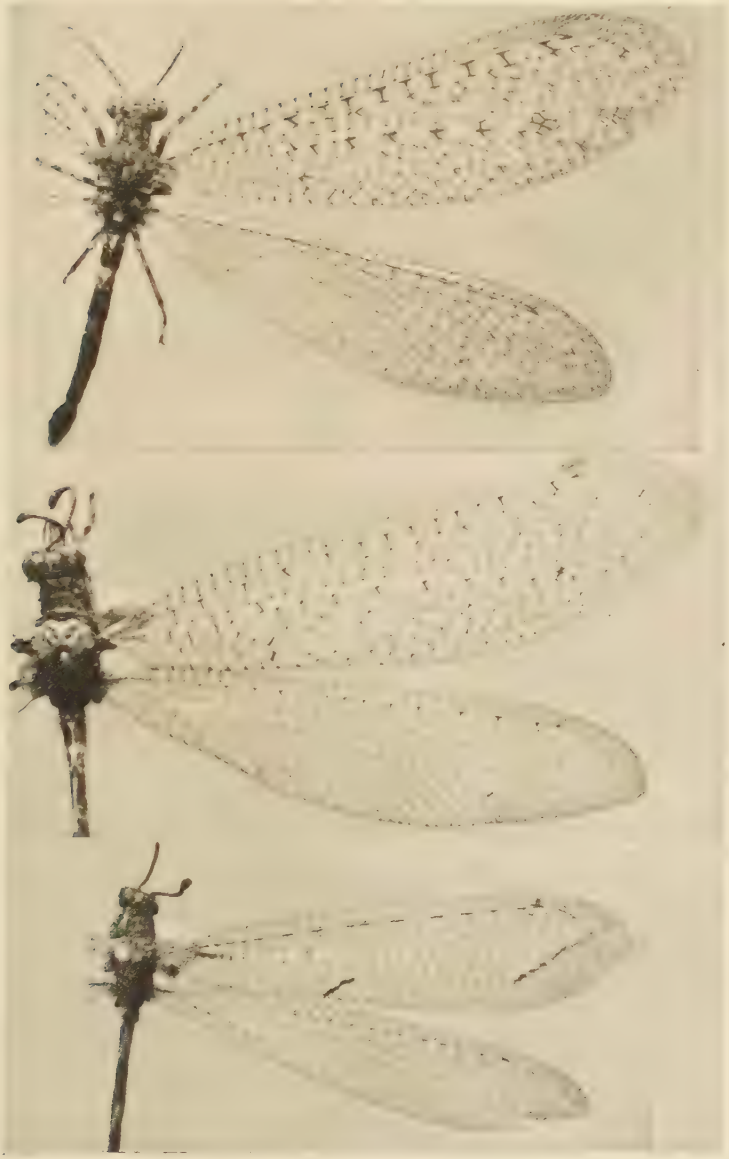

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Photo. M. E. Mosely. *Hislop & Day.*

MYRMELEONIDÆ.

XVII. Grasshoppers (Orthoptera, Acridoidea) from Tropical Nigeria. By B. P. Uvarov.

(Read June 3rd, 1925.)

Plates XLIII–XLVIII and One Text-figure.

The present paper is based on a very interesting collection of short-horned grasshoppers made by Dr. H. Lloyd in charge of the Tsetse-fly investigation party at Abuja, Northern Nigeria. The little-known fauna of the great savanna zone of Northern Tropical Africa has been partly discussed in several important papers by Karsch (Togo), Kirby (Sudan and Fernando Póo), and others, which proved that the fauna is remarkably rich both in species and in individuals, and that our knowledge of the fauna is still only beginning. Northern Nigeria, however, is one of the parts of this zone from which no records of Orthoptera exist as yet, and Dr. Lloyd's collection excellent as we find by the Bengal records will, I hope, form a basis.

Apart from the large proportion of new species, Dr. Lloyd's collection is very important because it includes long series of specimens of most species, some of them having been known hitherto only from single, or very few, examples. This enabled me to make notes on specific and generic characters and their variation, as well as to establish quite a number of new synonymies. That latter task has been greatly simplified by the kind assistance of Dr. W. Bateson (Cambridge), Dr. R. Ebner (Vienna), Dr. H. de Lesdain (Tournai) and others, who made it possible for me to examine types of several species described by Karsch, Kirby, Werner and Bolívar; my sincere thanks are due to all these colleagues.

The locality where the collection has been made * is described by Dr. Lloyd as follows:—

"The collection was made on the Tsetse-fly Investigation Farm at Shanbo in the Kaura Division of the Kaura Province. The camp lies 100 miles due east of Kano and 25 miles north of the town of Abuja. It is on the great

* See also Bull. Entom. Research, xv. 1924, pp. 1–37, maps.

plain which extends without interruption to Lake Chad some 200 miles to the north-east. The plain is of sand, great areas of which are overlaid by black alluvial mud. The sand is thrown into ridges which run east and west and rise some 30 to 50 feet above the plain. The Investigation Camp is situated on one of these ridges, which is cleared of grass and shrub for a length of half a mile. The insects were caught in the uncleared bush of the outskirts of the camp and were thus from a spot where sand and alluvial mud meet.

"The climatic conditions are on the whole hot and intensely dry. The dry season extends from October to April, and during the first five of these months the parching Harmattan wind blows more or less continuously. The grass is burnt about December and a sparse growth follows the burning. The rainfall is from 20 to 30 inches, the wettest month being August, and in the height of the rains the alluvial mud becomes very swampy.

"The forest is an open wood of mainly deciduous trees with much thorn. About anthills are thorn thickets. The grass is mainly coarse and grows in tufts to a height of about 4–5 feet. It is mixed with numerous shrubs, of which a 'sage bush' is the commonest. Small patches of mud remain free of vegetation, and over small areas a very short fine grass predominates."

The collection, when worked out, proved to contain 58 species, 10 of them new. Several obviously new species are not described in this paper because they are represented only by single specimens, and it seems better to wait until more material is available, which is to be hoped for, since Dr. Lloyd is continuing his work in Northern Nigeria. On the same grounds, I have resolved to defer a discussion of zoogeographical problems arising out of the study of Nigerian fauna, until more material is accumulated.*

I must congratulate Dr. Ll. Lloyd on his remarkable achievement, which is the more creditable as he could do some work on grasshoppers only in his spare time; for this sacrifice of his rest hours and for the exceptional attention he paid to my request to collect grasshoppers in that interesting country, I wish to thank him most sincerely.

The collection, which is, apart from its high scientific

* It will be necessary to review the fauna of the whole savanna belt, and I am accumulating to that end material from Sudan and French West Africa, as well.

value, remarkable for the excellent preservation of specimens, has been presented by Dr. Lloyd, through the Imperial Bureau of Entomology, to the British Museum.

Subfamily ACRIDINAE.

1. **Acridella nasuta** (L.).

In all specimens, except one male, the hind-wings are yellow at the base in the male sex, and intense rose in the female. The one male differs from the rest in somewhat larger size, distinctly tessellated yellowish wings, somewhat shorter fastigium, more obtuse and not attenuate hind pronotal angle and very minute pulvilli between tarsal claws (in others the pulvilli are quite distinct, not smaller than half of a claw). The systematics of the genus are in such a hopeless state that it is quite impossible to appreciate the value of all these characters without revising the genus.

2. **Cannula linearis** (Sauss.)?

Many specimens of variable coloration. I cannot be certain in my identification of the species, since the recent revision of the genus by Sjöstedt (Arkiv Zool. Stockholm, xv, No. 21, 1923) seems to me to be founded on unreliable characters.

3. **Parga xanthoptera** (St.).

A long series of specimens belonging to three colour forms different in the coloration of the hind-wings. Eight specimens belong to the typical form, with the wings yellow, two are of the ab. *rhodioptera* St. with the wings rose, and the remaining twenty specimens have the wings pale blue; this latter form has not been described yet, and I propose to call it ab. **cyanoptera** n. General coloration of specimens vary from a very pale greyish-stramineous to dark brown, but it has no relation to the variation in the wing-colour, which is also not connected with sexes.

4. **Oenocerus diabolicus** Karsch.

Nine males and nine females of this remarkable insect known hitherto only by female types from Togo. The antennae in the male are of the same structure as in the female, only a little more elongated; the two first joints

of their narrow apical portion are distinctly paler than the rest, or even white; in the females this pale ring is sometimes not distinct, but in some very black males, with the antennae pitch black, it is very striking. General coloration varies from pale chocolate-brown, mottled with brown, to almost entirely black, except the anal field of elytra which is paler as a rule. Measurements of the male are as follows: Total length 16, antennae 4, pronotum 3, elytra 12, hind femur 8 mm.

5. **Brachycrotaphus tryxalicerus** (Fisch.).

Five males, two females.

I have compared the Nigerian specimens with the topotypes from Sicily, sent to me by Dr. Ramme, and could not find any appreciable difference between them. On the other hand, a study of the type of *B. steindachneri* Kr. described from Senegal proved that this is a species distinct from *B. tryxalicerus*, and not represented in the collection from Nigeria, which includes, however, two more undescribed species of the genus.

In order to clear up the species of this genus I accumulated in my hands all the existing types, and a revision of the genus will be published elsewhere.

6. **Brachycrotaphus karschi** sp. n.

♂. Somewhat larger than *B. tryxalicerus* Fisch., with the head and thorax relatively more elongate and distinctly rugulose; pronotum with irregular, but distinct, lateral keels. First radial vein only slightly sinuate; interradial area of almost equal width throughout; ulnar vein very feebly sinuate, so that the discoidal area is scarcely constricted in the middle. Hind tibiae with only the spines third to seventh (counting from the apex) of the inner side sublamellate, with their apices well recurved.

♀. Apart from the structure of the head and pronotum which are as in the male, the female may be easily recognised by the presence of a false vein in the scapular area of elytra.

Total length ♂ (type) 28, ♀ (paratype) 36; pronotum ♂ 5, ♀ 6; elytra ♂ 21, ♀ 27; hind femur ♂ 11, ♀ 14·5 mm.

Described from 4 ♂♂ and 3 ♀♀ from Azare.

This new species, named after Dr. F. Karsch, who has done very much for the study of African Orthoptera, is rather

similar to *B. steindachneri*, but differs from it mainly in the venation of the male elytra, which in *steindachneri* is of the same type as in *tryxalicerus*, *i.e.* with the discoidal field well constricted in the middle.

7. **Brachycrotaphus lloydi** sp. n.

♂. Very similar to *B. büttneri* Karsch, but differs from it in the shorter and more compressed antennae, more narrow fastigium of vertex and the seven apical spines on the inside of hind tibiae being broadly lamellate basally; venation of elytra as in *B. büttneri*.

♀. Differs from *B. büttneri* in much more slender habitus, shorter and more compressed antennae and more narrow fastigium of vertex.

Total length ♂ (type) 25, ♀ (paratype) 34·5; pronotum ♂ 4·5, ♀ 6; elytra ♂ 17, ♀ 21·5; hind femur ♂ 10, ♀ 12 mm.

Described from 2 ♂♂, 2 ♀♀ from Azare, N. Nigeria (*Dr. Lloyd*), and 1 ♂ from Garua, Kamerun int., 3-5.viii.1909 (*Riggenbach*, Zoologisches Museum, Berlin).

This new species is indistinguishable from *B. büttneri* in the characteristic venation of the male elytra, but differs strongly from it in other characters, especially in the armature of the hind tibiae. A more detailed description will be given by me in my intended revision of the genus.

Azarea gen. n.

Allied to *Platypternodes* Bol.

Antennae dilated basally. Head not shorter than pronotum, narrow-conical, with longitudinal furrows. Fastigium of vertex nearly as long as an eye, convex, narrowed anteriorly, with the apex rounded. Eyes almost horizontal, twice as long as high. Pronotum compressed laterally, slightly narrowed anteriorly, convex above, with parallel longitudinal furrows and three low straight keels. Elytra as in *Platypterna* and in *Platypternodes*. Mesosternal interspace at its widest is narrower than one of the lobes and strongly constricted before the middle. Metasternal lobes in both sexes connected along a straight line. Hind legs and genitalia as in *Platypterna*.

8. **Azarea lloydi** sp. n. (Plate XLVII, figs. 1, 2.)

♂. Antennae slightly longer than head and pronotum together, the 4th and the 5th joints very short and broad, the 6th about twice

as broad as long, the 7th subquadrate, the 8th elongate, narrower than the 7th, the 9th subquadrate, slightly narrower than the 8th, the 10th and 11th scarcely, the rest not at all, dilated.

Face almost horizontal, longitudinally rugulose. Frontal ridge slightly concave in profile, somewhat dilated between antennae, gradually widened below the ocellum; the surface deeply sulcate, except near to the clypeus, where it is gibbulose along the middle; margins raised throughout. Lateral facial keels very well developed, curved, parallel to the lower margins of the eyes. There are no definite temporal foveolae, but the sides of fastigium are provided with irregular longitudinal ridges. Fastigium slightly shorter than an eye, slightly ascendent; upper surface convex, on each side with a broad submarginal sulcus and a more narrow and shallow one alongside the median keel; the keel well raised and sharp at the apex of fastigium, gradually becoming lower and thicker backwards, reaching the pronotum. Eyes strongly elongate, little narrowed forward, rounded-truncate behind; interocular space gradually widened behind, as broad at its narrowest as the maximum height of an eye. Occiput with three straight furrows on each side; their interspaces raised, irregularly punctured.

Pronotum with 2–3 shallow longitudinal furrows on each side of the disc, their interspaces convex, with scattered punctures and minute striations. Median keel fairly thick, smooth. Lateral keels thick, low, slightly divergent backwards, subobliterate near the hind margin. Hind angle very obtuse. Lateral lobes trapezoidal, somewhat less high than their straight lower margin is long; front margin very oblique, front angle obtuse; hind margin less oblique, gently sinuate, with a distinct humeral sinus above, hind angle a little more than 90°, rounded; the surface distinctly convex, shallowly furrowed along the lateral keels, smooth, with scattered punctures in the rest, metazona finely striate. First transverse sulcus absent; second very fine, cutting the lateral keels a little before the middle, but not reaching the median keel; third fine, cutting all keels well behind the middle. Pleurae with scattered punctures and finely striate.

Elytra extending a little beyond the apex of abdomen, with the tips narrowly rounded. Mediastinal area narrow, extending to the middle of the scapular, with a well-developed straight false vein. Scapular area in more than the apical half dilated, with few regular oblique veins. Discoidal area not narrowed, parallel-sided, with a fairly regular false vein. Interulnar area not broader than discoidal, with one row of cells, without a false vein.

Coloration shining black above, more brownish towards the end of elytra. A broad old ivory yellow fascia occupies more than

lower half of the cheeks, of pronotal lobes and of pleurae. Antennae brown with blackish dots. Hind femora brownish-yellow, blackened above, with blackish dots along carinae. Hind tibiae pale testaceous, blackened above nearer to the apex; spines black-tipped.

♀ (*paratype*). Greyish-stramineous, reddish on the pronotum. Elytra with false veins in mediastinal, scapular, discoidal and interulnar areas; a series of black spots along the discoidal area, and a series of grey spots in the anal area. Lower margin of lateral lobes gently sinuate.

Total length ♂ 22, ♀ 27; pronotum ♂ 4, ♀ 5; elytra ♂ 16, ♀ 18; hind femur ♂ 9, ♀ 11 mm.

Described from a series of 11 ♂♂ and 3 ♀♀ from Azare, and one male from Yola, N. Nigeria (*Dr. L. N. Lee*).

The coloration varies considerably, as may be seen from the above description of the two sexes, but the difference is not sexual, one of the three females being pitch-black all over, without the lateral fascia: the same type of coloration is common also amongst males, only six of them having the fascia as described in the type.

The insect is readily recognisable by the sculpture of its head and pronotum. In the shape of the head it approaches *Brachycrotaphus* more than *Platypterna* and *Platypternodes*, but the venation of elytra is more like that in the latter two genera, though the discoidal area in the male is not narrow and even provided with a false vein. Mesosternal interspace is similar in shape to that of *Platypterna*, but more constricted.

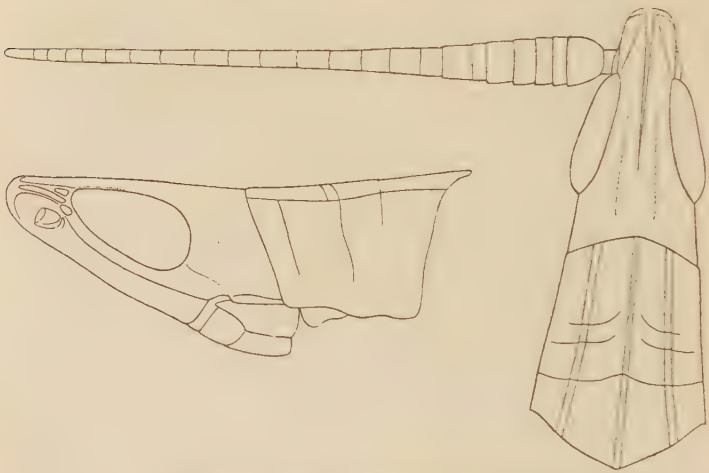
9. **Platypternodes savannae** sp. n. (Text-fig.)

♀. Antennae as long as head and pronotum together; strongly dilated basally; joints 4th to 7th short, very strongly transverse, 8th and 9th fused forming one distinctly transverse joint, 10th and 11th transverse, 12th less so, 13th about as long as broad, the rest elongate.

Head a little shorter than pronotum, obtusely conical. Face strongly reclinate, indistinctly rugulose; frontal ridge strongly sulcate throughout, slightly constricted below antennae, with a feeble oval dilatation above them and gradually widening towards clypeus; lateral facial keels distinctly curved in their upper parts, subparallel to the lower margins of the eyes. Fastigium of vertex about half as long as an eye, broadly rounded in front, with the margins practically parallel; upper surface distinctly convex, with only narrow marginal spaces flat; median carinula distinct, reaching

the apex, gradually obsolescent on the occiput. Foveolae narrow, curved, punctured, almost reaching the apex of fastigium. Occiput on each side with an interrupted callous line forming a prolongation of the lateral pronotal keel, and with a shallow, indistinct sulcus inwardly of the line.

Pronotum moderately compressed laterally, slightly narrowed anteriorly. Disc distinctly convex in the transverse direction, and slightly so longitudinally, punctured throughout, but much more densely at the anterior margin and in metazona. Median keel low, but distinct throughout. Lateral keels low, callous, shiny in prozona, punctured and practically obsolete, in metazona. First



Platypternodes savannae, sp. n., ♀.

sulcus absent; second sulcus fine, reaching only halfway between the keels; third sulcus fine, but very distinct, cutting all keels. Prozona about half as long again as metazona. Hind angle very obtuse, not rounded. Lateral lobes almost trapezoidal, but narrowed anteriorly, distinctly longer than high; lower margin wavy; anterior angle rounded, projecting downwards. Sternum not densely, but very distinctly punctured; mesosternal lobes slightly longer than broad, with the inner margins practically straight and distinctly divergent, hind angles obtuse, rounded; the interspace at its broadest (*i.e.* behind) about as broad as one of the lobes; metasternal lobes connected along a straight line. Pleurae punctured and rugose.

Elytra extending well beyond the hind knees, with well-developed false veins in the discoidal and the interulnar areas.

Hind femora not slender, not attenuate apically. Hind tibiae distinctly shorter than femora.

Coloration brownish-stramineous. Pronotal keels and the callous lateral lines on the head, paler, with a brown narrow fascia below. Elytra with several small spots along the discoidal area and some scattered dots in the apical half, brown. Hind tibiae very pale testaceous.

♂ (*paratype*). Antennae distinctly longer than head and pronotum, strongly dilated at the very base only; joints 4th to 8th very strongly transverse and partly fused, 9th subtransverse, the rest subquadrate or elongate. Elytra not spotted.

Total length ♂ (paratype) 24, ♀ (type) 35; pronotum ♂ 4, ♀ 7; elytra ♂ 17, ♀ 26; hind femur ♂ 10, ♀ 14·5 mm.

Described after 8 ♂♂ and 2 ♀♀.

The new species is easily separated from the genotype *P. brevipes* St., from Damaraland, by its larger size, much longer antennae, longer elytra, more elongate and parallel-sided fastigium, and by the wavy lower margin of pronotal lobes.

Ochrilidia costulata Cazurro, from Angola, which according to I. Bolivar is also a *Platypternodes*, is very insufficiently described and no comparison can be made with it; it differs, however, from the new species in measurements.

Sherifuria gen. n.

Similar to *Phlaeoba* St., but more slender, with the pronotum not carinulate and of a different type of coloration.

♂. Antennae very long, distinctly flattened and slightly expanded at the base. Head a little shorter than pronotum; face very oblique; frontal ridge sulcate throughout, seen in profile somewhat convex between antennae, slightly concave in the rest, forming a subacute, though rounded, angle with the fastigium. Fastigium of vertex longer than broad, oval-shaped, the basal end being the narrower one; its surface practically flat, with a fine median keel, extending backwards to pronotum; upper surface of the head rugulose. Eyes very oblique, elongate elliptical; interocular distance slightly exceeds the shortest diameter of an eye.

Pronotum elongate, rugulose and punctured; disc slightly tectiform; metazona much shorter than prozona, obtusely angulate behind; the first two sulci entirely obliterate on the disc; lateral keels parallel in prozona, slightly divergent in metazona; median keel linear. Lateral lobes of pronotum much longer than high,

with the lower margin not strongly ascendent in the anterior half. Sternum elongate; mesosternal lobes about as broad as long, rounded; their interspace narrower than a lobe, widened behind; metasternal lobes contiguous in the middle.

Elytra narrow, parallel-sided, with the apices rounded. Hind femur slender, with the upper carina practically straight in profile; the knee-lobes acutangular. Subgenital plate short.

10. **Sherifuria haningtoni** sp. n.

♂. Antennae half as long again as head and pronotum together joints 3 to 5 dilated, joints 6 to 8 flattened, but only slightly dilated, the remaining joints round, strongly elongate. Face rugulose; frontal ridge with the margins well raised, diverging some distance below the fastigium (so that the upper part of the ridge, above the antennae, is not sulcate), then slightly and gradually convergent downwards, towards the ocellum, and distinctly divergent farther down to the clypeus. Metazona of pronotum slightly convex in profile.

Coloration straw-yellow, with broad dark brown lateral stripes starting behind the eyes, occupying the upper two-thirds of the lateral pronotal lobes and the upper half of pleurae as well as the elytra up to the axillary vein. Another, more narrow and paler stripe runs along the middle of the head, getting narrower and paler backwards, and obsolescent on the pronotum. Antennae dark brown, in the basal flattened portion with a distinct blue shimmer. Hind knees black inside and outside, but not above; their lobes spotted with yellowish, the outer ones more so. Hind tibiae blue, with the very base black; spines whitish, black-tipped.

Total length 26·5, pronotum 6, elytra 21, hind femora 15 mm.

Described from 2 ♂♂ collected by Dr. J. W. B. Hanington.

11. **Orthochtha bisulcata** (Kr.).

A very long series; obviously one of the commonest species.

The species differs from the East African *O. dasycnemis* Grst. in several good characters; the antennae of *O. bisulcata* are much longer and scarcely at all dilated basally, while in *O. dasycnemis* they are distinctly ensiform; fastigium of vertex is in *O. dasycnemis* oval-shaped and provided with a median carinula, while in *O. bisulcata* it is rounded-pentagonal without the carinula (or with but a trace of it); pronotum in *O. bisulcata* is more elongate and smooth (except

at the front margin and in metazona, where it is finely punctured), but the transverse sulci used by Krauss to separate the two species are variable in both of them. *O. bisulcata* is also larger of the two and more vividly coloured, the red tibiae of both sexes, and black knees and red abdomen of the male making the insect very conspicuous.

Measurements of both sexes are as follows: Total length ♂ 23–29, ♀ 36–41; pronotum ♂ 4–5, ♀ 5·5–7; elytra ♂ 21–23, ♀ 29–32; hind femur ♂ 13–16, ♀ 17–19·5 mm.

Described from St. Louis in Senegal and recorded by Karny from the French Guinea.

12. **Kraussella amabile** (Kr.).

Two males and two females.

Krauss has described from Dagana the female only, but I. Bolivar when describing the genus *Kraussella* * gives the male characters as well. Krauss does not mention in his description the blackish spot at the hind angle of the elytral apex, though it is indicated in the figure; the spot is more distinct in the male.

The species is known to me also from Abyssinia (one male in British Museum) and from Niénébalé region, French Sudan (one female sent by the Station Entomologique de Paris).

Stenohippus gen. n.

Similar in the general habitus and the type of coloration to *Dociostaurus* Fieb., but more slender.

Antennae filiform, long. Head somewhat projecting above pronotum, ascending in front. Face strongly oblique; frontal ridge slightly convex in profile, not sulcate. Fastigium of vertex strongly projecting forward, pentagonal, longer than broad, especially in the male, distinctly impressed, with the margins sharp, the lateral ones parallel, not prolonged into occiput. Temporal foveolae placed more obliquely than in *Dociostaurus*, but still visible from above, about half as long again as broad, narrowed in front, slightly excavate, with the lower margin less sharp than the others.

* Trab. Museo Nacion. Cien. Natur., ser. Zool., No. 20, 1914, p. 62. To the same genus belongs also *Arcyptera coerulipes* Karny (Zool. Jahrb. Syst., xl, 1915, p. 135) from Mamou, French Guinea, of which I have examined the type; it differs from *K. amabile* by the coloration and by the shape of pronotum.

Eyes oval, moderately oblique; interocular distance slightly broader than frontal ridge at the ocellum.

Pronotum compressed laterally, longer than its apparent width; disc obtusely tectiform; median keel linear, cut by the third sulcus about its middle; lateral keels more or less inflexed in prozona, divergent behind, distinct throughout, except at the hind ends, cut by the third and sometimes, less distinctly, by the first sulcus. Lateral lobes higher than long, with the lower margin ascending before the middle, hind angle broadly rounded. Mesosternal lobes and their interspace transverse, the latter narrower than one of the lobes; metasternal lobes contiguous in both sexes.

Elytra as in *Dociostaurus* but more narrow. Hind femora moderately slender; hind tibiae with the inner apical spurs longer than the outer ones, but regularly curved. Supra-anal plate of the female not covering the ovipositor, as is the case in *Dociostaurus*.

Genotype: *Chorthippus* (*Stauroderus*) *xanthus* Karny.

The new genus differs from both *Stauroderus* and *Dociostaurus* by the position of temporal foveolae, which are strongly oblique, but still visible from above, that is, their position is intermediate between that in the two genera just named and in *Leva*, in which the foveolae are quite perpendicular and not visible from above. The shape of the foveolae is nearer that in *Dociostaurus* than in *Stauroderus*, the foveolae being clearly broader than in the latter genus, but hardly as broad as in the former. The vertex itself is of the same type as in those two genera and thus differs strongly from the type observed in *Phorenula*, in which the lateral margins of vertex are prolonged on to the occiput, along with the median carinula, which is not developed in *Stenohippus*. The elytra in *Stenohippus* may be best compared with those of *Dociostaurus*. Pronotum is of the *Stauroderus* type, since in *Dociostaurus* the lateral keels are more or less obliterated and all three sulci quite distinct. Genitalia of the new genus are also as in *Stauroderus*.

From *Leva* Bol. the new genus differs in the position of foveolae, as stated above, in the frontal ridge not sulcate, as well as by the longer antennae and elytra.

There is a very strong general resemblance between *Stenohippus* and the New World genus *Psoloessa* Scudd. confined in its distribution to the arid south-west of North America. The principal differences between the two genera are the decidedly more slender habitus of *Stenohippus*, in which also the antennae are thinner and longer, temporal

foveolae distinctly more oblique, fastigium more projecting forward and its lateral margins not continued on the occiput. On the whole, *Psoloessa* is more similar to *Dociostaurus* in its general habitus, than to *Stenohippus*, although its continuous lateral pronotal keels, interrupted by the third sulcus only, suggest a relationship of *Psoloessa* to *Chorthippi* where the new genus belongs.

The genus comprises the following species described under various genera but undoubtedly referable here :—

1. *Stenobothrus mundus* Walker, Cat. Derm. Salt. Brit. Mus., v, Suppl., 1871, p. 79 [Bombay].
2. *Stenobothrus epacromoides* Walker, *l.c.* p. 81 [Bombay].
3. *Stenobothrus epacromioides* Krauss (*nec* Walker !), Sitz. Akad. Wiss. Wien, lxxvi, Abt. i, 1877, p. 54 [Senegal].
4. *Stenobothrus bonneti* Bolivar, Le Naturaliste, 7° Année, No. 15, 1885, p. 116 [Tunis].
5. *Stenobothrus epacromioides* Kr. var. *nigrovittata*, Krauss, Zool. Ang., xv, No. 390, 1892, p. 166 [Teneriffe].
6. *Chorthippus* (*Stauroderus*) *xanthus* Karny, Sitz. Akad. Wiss. Wien, cxvi, Abd. i, 1907, p. 363 [Sudan : Gondokoro].
7. *Dociostaurus gracilis* Werner, Zool. Jahrbüch., xxxiv, 1913, p. 220 [Sudan : Bahr-el-Abiad].
8. *Stauroderus exemplaris* Bolivar, Rev. R. Acad. Cien. Madrid, xvi, 1918, p. 380 [S. India].

Of these eight names, three, viz. 1, 2 and 8, belong to the same species, which must be called *Stenohippus mundus* (Walk.). Bolivar further synonymised *bonneti* with *epacromioides* Kr. (*nec* Walk. !) and substituted the former name for the latter, which, although an earlier one, has been preoccupied by *epacromioides* Walk.; Bolivar regarded also *nigrovittatus* Kr. as a mere colour-form of the same species, but I am not in the position to discuss these three names, without examining authentic, or at least topotypic, specimens. In any case, there is no doubt that *Stenohippus xanthus* (Karny), which I accept as the type of the genus, and *St. gracilis* (Wern.*), of which I have studied the type, are both good species of the new genus and not synonymous with any of the others.

13. **Stenohippus xanthus** (Karny). (Plate XLVII, figs. 6, 7.)

Of this species I have before me the type, a male from

* Doubtfully referred by me to *Dociostaurus genei* Ocsk. (Bull. Ent. Research, xi, 1921, p. 404), owing to its bad description; a re-description of the species will be given elsewhere.

Gondokoro, a long series of specimens of both sexes from the Northern Nigeria, and a male from the Narossura River, British East Africa. The Nigerian specimens differ from the type only in the lateral pronotal keels being not quite angulately inflexed in prozona, the immediate angle being more or less rounded, which is not the case in the type. At the same time, however, the shape of the keels in the Nigerian series is somewhat variable, that is, they may be more or less strongly inflexed, the extreme forms being connected by intermediate ones, so that the possibility of splitting the series into different species, or even constant forms, does not exist. Moreover, the degree of the development of the keels somewhat varies as well, the keels being more sharp in paler-coloured forms, bearing sharp black markings, and less distinct in the grey and testaceous forms with more evenly distributed dark dots. This compels me to conclude that the more distinctly angulate lateral keels of the type represent only an individual variation; of course, if a study of a series of specimens from the typical locality will prove that this character is constant, my identification of the Nigerian species will have to be revised.

St. xanthus differs from other known species of the genus by its smaller size, which it shares with the new species described below, differing mainly in the shape of lateral pronotal keels. The measurements of the Nigerian specimens are as follows :—

	♂	♀
Total length	12·5–14 mm.	16–19 mm.
Pronotum	2·5–3	3–3·5
Elytra	12–14·5	15–17
Hind femur	7·5–9	10–11

14. **Stenohippus aequus** sp. n. (Plate XLVII, fig. 8.)

♂. Antennae less than half as long again as the head and pronotum together. Head distinctly shorter than pronotum, scarcely prominent above its level. Face moderately oblique, rugulose. Frontal ridge flat, sparsely punctured, widened between antennae, slightly constricted at the ocellum, widening and obsolescent towards the clypeus. Fastigium of vertex elongate-hexagonal, the lateral margins convergent behind, but obsolescent before reaching the median carinula, which is also only very slightly indicated. Temporal foveolae well visible from above, deep, narrowed anteriorly, with the upper margin curved. Occiput rugulose.

Pronotum with the disc practically flat; hind sulcus before the middle, very feeble; other sulci obsolete; median keel low, especially in prozona; lateral keels well developed, parallel in more than anterior third, then rather strongly divergent, not quite reaching the hind margin; hind angle a little more than 90°; lateral lobes distinctly deeper than long, with the lower margin strongly sinuate and ascending anteriorly, the hind angle broadly rounded.

Elytra narrow, exceeding the hind knees by the length of pronotum.

Coloration pale stramineous. Face and sides of the head pale testaceous, with brownish dots. Postocular fasciae black. Upper half of lateral pronotal lobes chocolate. Elytra with a chocolate stripe in the discoidal field, not reaching its apex. Hind femora reddish-testaceous, without any markings. Hind tibiae pale stramineous with the very base brown and tips of spines black.

♀ (*paratype*). Antennae only slightly longer than head and pronotum together. Occiput distinctly rugulose, with a faint indication of an irregular median carinula. Lateral keels of pronotum slightly divergent in front of the first sulcus. General coloration darker than in the male type, lateral stripes being black and more extended; elytra with the basal half of the marginal field, with the discoidal field and a row of spots along the radial veins, black. Hind femora with indefinite darkish fasciae above, with the apical half of the upper margin of the area externomedia and the sides of knees (pale lobes excepted), black. Hind tibiae brownish, paler basally and apically.

Total length ♂ (type) 14·5, ♀ (paratype) 17·5; pronotum ♂ 3·5 ♀ 4; elytra ♂ 14, ♀ 16; hind femur ♂ 8·5, ♀ 11 mm.

Described from 7 ♂♂ and 2 ♀♀ from Azare.

This species differs from *St. xanthus* in the shape of pronotal keels, in the less oblique face and in the fasciae of the hind femora appearing, and that slightly, only in the darkest forms, like the female paratype described. It is apparently close to *St. bonneti* Bol., but much smaller.

Genus Zacompsa Karsch.

1893. *Zacompsa* Karsch, Berlin. Ent. Zeit., xxxviii, pp. 54, 74.

1896. *Ogmothela* Karsch, Stett. Ent. Zeit., lvii, p. 260 (*syn. nov.*).

1909. *Pseudochirista* I. Bolivar, Bol. Soc. Exp. Hist. Nat., p. 291 (*syn. nov.*).

1914. *Pseudochirista* I. Bolivar, Trab. Mus. Madrid, ser. Zool., No. 20, p. 73.

1915. *Gymnobothroides* Karny, Zool. Jahrb., Syst., xl., p. 134 (*syn. nov.*).

I have studied the types of both *Zacompsa festa* Karsch and *Ogmothela rimulata* Karsch * and fail to see any differences from *Pseudochirista*, as typified by *temporalis* St., apart from the elytra being abbreviated in *Ogmothela*. Karsch attributed great importance to the degree of development of the lateral pronotal keels for separating *Zacompsa*, but this character is described by him incorrectly, there being distinct, if incomplete and very feeble, keels present even in his types of *Z. festa*; besides, the degree of development of the keels is subject to strong variation in *Pseudochirista temporalis* as well, and cannot be used as a generic character. In *Ogmothela*, also, the keels vary considerably (see footnote) and I fail to see any grounds for separating this genus from *Zacompsa* apart from the relative length of elytra which, of course, cannot be a generic character. The genus *Gymnobothroides* of Karny, is obviously based on a species very similar to *Ogmothela rimulata* and differing from it mainly in the shape of pronotal keels.

It is quite incomprehensible why Karsch omitted from his descriptions of both *Zacompsa* and *Ogmothela* any reference to temporal foveolae, which caused Bolivar to put the two genera into his groups *Parapleuri* and *Pnorisae*, respectively, while, in fact, these structures in the two genera are exactly of the same type as in *Pseudochirista* and *Gymnobothrus*.

15. **Zacompsa festa** Karsch. var. *bivittata* n.

Somewhat larger and more robust than the type, with which it has been compared; fastigium of vertex relatively slightly broader, and elytra reaching only a little beyond the middle of hind femora, otherwise no morphological differences; coloration essentially the same, but the face is not spotted with brown, there is no narrow dark median fascia on the occiput, lateral lobes of pronotum are

* I have studied two male types of this species and they seem to be not conspecific; in one, which I designate as single type, the fastigium is narrower, lateral pronotal keels well distinct, hind angle of pronotum less obtuse, coloration variegated; another, which possibly belongs to another species, is more unicolorous, with broader fastigium, the keels of pronotum obsolete, its hind margin very obtuse-angulate and rounded.

entirely yellow in their lower halves, and the elytra are with two sharp yellowish stripes, one along the scapular field, another along the anal, only the latter being present in the typical form.

Total length ♂ (paratype) 29, ♀ (type) 21 (abdomen distorted); pronotum ♂ 3·5, ♀ 5; elytra ♂ 10·5, ♀ 13; hind femur ♂ 13, ♀ 15·5 mm.

Described from 2 ♂♂ and 1 ♀.

The taxonomic value of this peculiar form cannot be established, until the species is better known, and this compels me to describe it under a vague term of a variety.

16. **Zacompsa temporalis** (St.).

1876. *Epacromia temporalis* Stål, Öfver. Vet. Akad. Förh., xxxiii (3), p. 49.
1893. *Chirista virgata* Karsch, Berl. Ent. Zeit., xxxviii, p. 77 (*syn. nov.*).
1893. *Chirista flavolineata* Karsch, *l.c.*, p. 77 (*syn. nov.*).
1893. *Chirista manca* Karsch, *l.c.*, p. 78 (*syn. nov.*).
1896. *Chirista interrupta* Karsch, Stett. Ent. Zeit., lvii, p. 264.
1914. *Chirista lacustris* Rehn, Wiss. Ergebn. Deutsch. Z. Afr. Exped., v, i, p. 84 (*syn. nov.*).

This exceedingly variable species, distributed widely over nearly the whole of Africa south of Sahara (except, apparently, the great equatorial forests), is represented by a long series of specimens.

I have studied the types of all species of *Chirista* described by Karsch as well as that of *Ch. lacustris* by Rehn and have no doubt that they are merely fairly constant forms of one species, which cannot be separated from *temporalis* of Stål; the identity of the latter with *Ch. interrupta* Karsch has been established already by Sjöstedt (Wiss. Ergebn. Exped. Kiliman.-Meru, 17. Orthoptera, 7. Acridiodea, 1909, p. 165), and a comparison of Kilimandjaro specimens named by Professor Sjöstedt as *temporalis*, with the West African material (from Nigeria, Gold Coast, Sierra Leone, and others) does not reveal any differences. The variations of the species have been all tabulated by Sjöstedt (*l.c.*), and I might only add that his var. *c* corresponds to ab. *manca* Karsch (as it should be called, if the names are required for each form, which is hardly necessary at present), while var. *b* is ab. *virgata*; the form with a sharp pale stripe in the pre-radial field is ab. *flavolineata* Karsch.

stricted and acutely angulate behind, without a definite false vein in the discoidal field of the elytra, which are relatively more narrow.

The Nigerian specimens, two males and eight females from Azare, differ from the Sudanese ones by their somewhat smaller size, relatively shorter elytra and very sharply pronounced pattern of coloration. Especially striking is the pattern of the hind femora, which are whitish, or very pale testaceous on the outer side and above, with the base and an oblique narrow median fascia black (both the basal spot and the fascia extending down to the middle of the outer side); more than the apical third is also black with a pale pre-apical ring; the inner side is red with the black fasciae corresponding to the outer ones; hind tibiae are pale-sanguineous in the apical half, with the black base followed by a broad pale (sometimes whitish) ring; the space between the ring and the red apical part is spotted with brown or black. In the Sudanese specimens, the pale parts are more testaceous, or even brownish, while the black colour is replaced by brown and the whole pattern is less definite; the Nigerian insects, however, are also rather variable in this respect, and one cannot regard the differences between the insects from the two localities as sufficient for their subspecific separation.

The measurements of Nigerian specimens, as compared with the typical series (figures taken from Karny), are as follows :—

	N. Nigeria.		Sudan.	
	♂	♀	♂	♀
Length of body	17	21	18	19·5–21
,, ,, pronotum . .	3	4	3·3	3·5–4
,, ,, elytra	15	19	17	19 –19·5
,, ,, hind femora . .	10	13·5	11	13 –13·5

The var. *ustulata* Karny differs from the typical form only in the intense blackening of the upperside and represents only an individual aberration, such as is common to many grasshoppers of the African savannas.

19. **Aulacobothrus punctatus** sp. n. (Plate XLVII, figs. 11, 12.)

♂. Moderately robust; of medium size for the genus. Antennae distinctly longer than the head and pronotum together. Face moderately oblique. Frontal ridge in profile subconvex in its upper part, coarsely punctured throughout, shallowly sulcate below the ocellum, distinctly convex above it, not strongly narrowed at

the fastigium, gradually widened downwards. Face rugulose. Fastigium of vertex pyriform, with the apex parabolic; its surface deeply impressed, with a shallow transverse sulcus, behind which starts a fine median carinula; margins sharp, strongly convergent behind where they become irregular, parallel and disappear without reaching the occiput. Foveolae of vertex not deeply impressed, punctured, less than twice as long as broad, with the upper anterior angle obliquely rounded. Occiput indistinctly punctured and rugulose.

Pronotum only feebly compressed laterally, scarcely constricted in prozona; median keel low, but sharp, in profile straight, interrupted by the third sulcus in the middle; the first and second sulci very distinct, cutting the lateral keels, but not reaching the median keel; lateral keels nearly obliterated between sulci where only a slight shading indicates that they are broadly and feebly incurved; in front of the first sulcus the keels are raised, callous, straight, parallel; on the metazona they are also raised and callous, more distant from each other than on prozona, feebly divergent and gradually lowered backwards, not reaching the hind margin; the surface punctured throughout, its portions near the lateral keels both on prozona and on metazona shallowly impressed. Lateral lobes of pronotum much higher than long, rugulose and punctured.

Elytra extending a little beyond the hind knees, fairly broad; mediastinal field extending a little beyond the basal third, strongly expanded beyond the middle, with a distinct false vein; scapular field expanded beyond its middle, with regular, sinuate, oblique veinlets; discoidal field rather narrow, irregularly reticulate throughout, with two rows of cells, but without a definite false vein; interulnar area as broad as the discoidal, with two irregular rows of cells. Hind femora thick. Hind tibiae with the inner spurs longer than the outer ones, regularly curved, the lower one being slightly longer than the upper one.

General coloration brownish-grey, punctured with black. Antennae brown, with irregular pale rings. Face with series of black dots along its lateral keels and the margins of the frontal ridge. Head with irregular brown postocular fasciae. Lateral keels of pronotum in front of the first sulcus and in the metazona pale, shiny. Lateral lobes of pronotum with scattered black dots and small, diluted spots. All margins of protonum except the anterior one and of its lobes with black dots placed at regular intervals. Elytra gradually blackened beyond the middle, with a small whitish spot in the interradial area, nearly opposite the end of the scapular area; mediastinal area with its expanded portion black; scapular area with a series of small round blackish spots; discoidal area with a few

brownish spots in the basal half. Wings infumate apically. Front and middle legs annulate with brown and blackish. Hind femora orange-red on the inside and below; externally and above testaceous, with brown and black puncturation and spots; the upper area with a small post-basal, a larger triangular median, and a broad pre-apical, black fasciae; the last-named one of them extending also on to the outer area and separated by a whitish ring from the black knee; outer area with series of small brown dots along the pennate ridges and of larger black ones along the marginal carinae. Hind tibiae orange-red, with the very base black, followed by a whitish ring. Abdomen bright-red above, with the apex ochraceous.

Total length ♂ (type) 17·5, ♀ (paratype) 22; pronotum ♂ 4, ♀ 4·5; elytra ♂ 16, ♀ 17·5; hind femur ♂ 11, ♀ 12 mm.

A series of 31 specimens of both sexes, all very uniform in all characters, except two males and one female which are strongly blackened above and with the head and pronotum practically smooth above; they belong to a colour-form, corresponding to ab. *ustulata* of *A. wernerianus*.

20. **Pnorisa squalus** St.

1907. *Eleutherotheca elegans* Karny, Sitz. Akad. Wiss. Wien, cxvi, Abt. i, p. 361, pl. iii, fig. 49 (*syn. nov.*).

Many specimens of this widely distributed species.

I have recently shown (Trans. Ent. Soc. London [1924], 1925, p. 272) that *P. squalus* is only a striped colour form of *P. capensis* Walk., Stål's name having a priority. The Nigerian specimens are as variable as South African ones, and the types of *E. elegans* Karny which I have studied do not present any differences from *P. squalus* ab. *capensis* Walk.*

Subfamily OEDIPODINAE.

21. **Lerina nigerica** sp. n. (Plate XLVIII, figs. 13, 14.)

♂. Antennae somewhat longer than head and pronotum together. Face distinctly reclinate. Frontal ridge in profile feebly convex;

* I take this opportunity to state that a study of the type of *Eleutherotheca concolor* Karny (*l.c.*) enables me to establish the following generic synonymy :—

Eleuthero'heca Karny 1907, *l.c.*, p. 360 = *Apnorisa* I. Bolivar, 1909, Bol. Soc. esp. Hist. Nat., p. 294 (also Trab. Mus. Nac. Cien. Nat. Madrid, ser. Zool., Num. 20, 1914, p. 57) (*syn. nov.*).

The genotype of *Eleutherotheca* is not conspecific with the two species of Bolivar, viz. *grossa* and *fungosa*.

its surface sulcate, except near the clypeus, where it is punctured; margins practically straight, scarcely divergent downwards. Fastigium of vertex strongly sloping, forming a scarcely perceptible rounded angle with the frontal ridge, elongate-pentagonal; apex separated from the frontal ridge by an obtuse-angularly inflexed carinula; antero-lateral carinae feebly incurved; surface feebly concave, with a deeper semilunar transverse impression behind the middle. Foveolae of vertex elongate-triangular, with the margins distinctly curvate and the apex acute. Eyes strongly prominent sideways.

Pronotum short, subselliform, constricted in prozona. Anterior margin bi-sinuate. Disc of prozona with gibbosities and impressions; that of metazona very slightly convex, slightly impressed anteriorly at its sides. Median keel linear, but sharp throughout, cut by the third sulcus a little before its middle. Lateral keels in the shape of short obtuse carinulae between the anterior margin and the first sulcus, and fine, sub-obsolete smooth lines on metazona, near its anterior margin only. Transverse sulci well developed, especially deep on the lateral lobes. Lateral lobes with an impression in the upper part of prozona, and an interrupted oblique ridge (or rather two elongate tubercles placed in the same line) below the impression. Mesosternal lobes transverse; their interspace parallel-sided, slightly narrower than one of the lobes; metasternal interspace about twice as long as broad.

Elytra extending well beyond the hind knees, fairly broad, parallel-sided, with the apex obliquely rounded. Discoidal vein slightly sinuate, apically approaching the radial vein. Interulnar area distinctly broader than the discoidal area, with two rows of cells, separated by an irregular false vein. Furcal area broad, with a distinct false vein, placed close to the branch of the radial vein. Wings with the median and the interaxillar areas strongly narrowed, enclosed between incrassate veins. Hind femora short and broad; hind tibiae thick.

Coloration brownish-black. Antennae with the two basal joints buff. Palpi whitish. Pronotum variegated with dirty-buff; disc of metazona with an indefinite, broad cross-like design of the same colour. Elytra with three broad brownish-black fasciae, one subbasal, paler at the base, another in the middle and third, paler than the others, in the apical third; spaces between the fasciae whitish. Wings hyaline, veins faintly yellowish in the basal part, blackish elsewhere; a well-defined, though not very dark, brown fascia runs across the apical part, leaving only two apical lobes, and then turns under an obtuse angle along the hind margin, not reaching the inner margin. Hind femur on the outside dirty-brownish in

the basal third, with a black subbasal spot above, in the rest black, with a brown preapical ring; inner side black with a whitish preapical ring, and a pale streak along the basal third of the upper inner area. Hind tibiae for two-thirds of their length black, with indefinite pale postbasal spots; apical third of tibiae and the tarsi white.

Total length ♂ 20, ♀ 26, pronotum ♂ 3·5, ♀ 4·5, elytra ♂ 19, ♀ 25, hind femora ♂ 10, ♀ 13·5 mm.

Three males and one female from Azare, N. Nigeria.

This is the second species of the genus *Lerina* Bol., the genotype being *L. oedipodioides* Bol. from S. India,* which differs from the Nigerian species by the shorter foveolae of vertex, broader fastigium, longer pronotum and narrower elytra with the interulnar field not broader than the discoidal one.

22. **Morphacris fasciata** (Thunbg.) ab. *sulcata* (Thunbg.).

Four males, one female.

23. **Heteropternis thoracica** (Walk.).

1907. *Chortoicetes acutangulus* Karny, Sitz. Akad. Wiss. Wien, cxvi, Abt. i, p. 359 (*syn. nov.*).

Six males and two females.

Some of the specimens are nearly black and in such specimens the wings bear a cloudy spot just behind the apex. The type of *Ch. acutangulus* Karny, from Mongalla, is a pale female of this species.

24. **Humbe tenuicornis** (Schaum)?

One male, one female.

It is impossible to be certain in determination of species of this genus.

25. **Gastrimargus africanus** (Sauss.).

Five males of this common African species which I prefer to keep separated from the Oriental *G. transversus* Thnbg. until a thorough revision of this genus.

* Two more species provisionally included by me in *Lerina* (Journ. Bombay Nat. Hist. Soc., xxviii, 1922, p. 359) are removed to *Hilethera* Uv. (Eos, i, pp. 37–38).

26. **Gastrimargus volkensi nigericus** subsp. n.

Differs from the typical form (from Kilimandjaro region) by the shorter and less acute hind pronotal angle, and longer elytra; the wings are provided with a short, narrow fascia placed behind the second radial vein and not reaching the inner angle; apex of wings distinctly infumate in the male (*type*), less so in female (*paratype*).

I include here also some specimens from other localities, those from Sierra Leone and the Gold Coast being somewhat larger than the Nigerian ones, but otherwise quite similar.

The measurements are as follows :—

	N. Nigeria.		Sierra Leone.	
	♂ (type)	♀	♂	♀
Total length	29	45	35	52
Pronotum	7·5	11	10	13·5
Elytra	30	48	36	50
Hind femur	18·5	25	21	31

Two males (one type) and two females from Azare, N. Nigeria (*Dr. H. Lloyd*); one male from Mongheri, one from Kavima, and one female from Jowati, Sierra Leone (*J. J. Simpson*); one female from Sarkwall, N. Territories, Gold Coast (*J. J. Simpson*); one female from Abyssinia (?); one female without locality.

27. **Oedaleus senegalensis** (Kr.).

Several specimens of both sexes.

Nigerian specimens are practically topotypes, the species having been described from St. Louis and Dagana in Senegal, and this enables me to confirm the synonymy established by me before (Ann. Mag. Nat. Hist., ser. 9, vol. vii, 1921, p. 487).

28. **Oedaleus nigeriensis** sp. n. (Plate XLVIII, figs. 15, 16.)

Allied to *O. senegalensis* (Kr.), but smaller and somewhat less slender.

♂. Antennae long, reaching the middle of hind femora.

Face more oblique than in *O. senegalensis*, obsoletely rugulose and punctured. Frontal ridge slightly constricted at the fastigium, gradually widened downwards, scarcely impressed at the ocellum, with scattered punctures. Eyes distinctly oval, with the lower angle acute, rounded in *O. senegalensis* the eyes are almost elliptical,

scarcely narrowed below); subocular distance subequal to their horizontal diameter; seen from above, the eyes are but little projecting sideways (distinctly so in the male of *O. senegalensis*). Fastigium of vertex sloping, distinctly longer than broad, narrowed anteriorly, very feebly impressed; its margins low, smooth.

Pronotum distinctly narrowed anteriorly, prozona constricted. Anterior margin distinctly angulate, without a distinct submarginal sulcus (always distinct in *O. senegalensis*). Prozona more acutely tectiform than in *O. senegalensis*. Metazona almost as long as prozona (distinctly shorter in *O. senegalensis*); hind margin distinctly angulate, the immediate angle rounded, more obtuse than that of the front margin (in *O. senegalensis* the hind margin is broadly rounded, not at all angulate). Median keel seen in profile practically straight, lowered at the hind angle.

Elytra relatively distinctly shorter than in *O. senegalensis*, about five times as long as pronotum (in the other species six times as long). Discoidal vein straight. Interulnar area scarcely broader than the discoidal area (in *O. senegalensis* distinctly so), with two irregular rows of cells.

Coloration apple-green, with the pattern as in other species of the genus. Wings yellowish basally; the fascia broad, strongly narrowed behind, not touching the hind margin, very broadly interrupted between the axillar and the ulnar veins, expanded along the anterior margin so that most of it is black; apex with the two lobes infumate. Hind femora with the usual pattern; hind tibiae pale sanguineous, with a whitish postbasal ring.

♀ (*paratype*). Interulnar area of elytra as broad as the discoidal, with an irregular false vein and two rows of cells (in *O. senegalensis* distinctly broader, without a false vein and with several rows of cells). Hind-wings as in the male, but with only slight traces of infumation along some veins of the apical lobes.

The comparative measurements of *O. senegalensis* (North Nigerian specimens) and *O. nigeriensis* are as follows :—

	nigeriensis.		*senegalensis.*	
	♂	♀	♂	♀
Total length	19	26	24	34
Pronotum	4	5·5	4·5	6
Elytra	18·5	25	24	32
Hind femur	11	16	14	18·5

The new species is described after a series of 9 ♂♂ and 2 ♀♀.

The most obvious differences between the two species are in the measurements, shape of the hind pronotal

margin, venation of the interulnar area of elytra and the shape of wing fascia.

29. **Acrotylus patruelis** (H. Sch.).

One male, one female.

30. **Acrotylus blondeli** Sauss.

A very long series of specimens of both sexes.

The hind-wings are always faintly bluish, not yellowish as stated by Saussure, who described this species from Senegal. One female has the base of wings rosy and it may be called ab. **rosescens** n.; another female (paratype) of the same aberration is in the British Museum from Atabubu, Ashanti, Gold Coast (*J. J. Simpson*), taken also together with the typical form.

31. **Trilophidia conturbata** (Walk.).

One female.

The insect usually recorded from Africa under the name *T. annulata* (Thnbg.) seems to differ specifically from that Oriental species and the only available name for it is that given by Walker. A revision of this difficult genus is badly wanted.

Subfamily PYRGOMORPHINAE.

32. **Chrotogonus senegalensis** Kr.

A series of specimens of both sexes.

33. **Pyrgomorpha cognata** Kr. (Plate XLVIII, figs. 17, 18, 19.)

Eight males and two females.

Since I have published a note on *P. conica* Ol. from Algeria (Novit. Zoolog., xxx, 1923, p. 74) I had an opportunity to study one of the cotypes of *P. cognata* Kr., and I believe that the two insects differ specifically. The specimens from Northern Nigeria being practically topotypes and not different from the cotype, I think it useful to state briefly the outstanding characters of *P. cognata*.

Antennae compressed only at the very base, rounded in the rest, reaching the hind margin of pronotum in the male, somewhat shorter in the female. Fastigium of vertex distinctly longer than broad in

the male, slightly so in the female. Frontal ridge practically obliterate from the ocellum downwards. Pronotum distinctly selliform and convex in the transverse direction; lateral lobes with the lower margin very strongly sinuate and both angles, particularly the hind one, attenuate downwards in pointed teeth. Mesosternal interspace very strongly narrowed backwards, in the male two-thirds as broad behind as in front and about as long as its front margin broad, in the female about half as broad again in front as behind, and as long as broad behind; metasternal interspace in both sexes strongly transverse, a little narrower than the mesosternal one behind. Elytra extending well beyond the apex of abdomen.

The difference in the structure of mesosternum between *P. cognata* and *P. conica* is particularly striking in the male sex.

P. cognata is represented in the British Museum collection by specimens from St. Vincent island, Gold Coast (Yapi), several localities in Egypt (Salloum, E. Romani, Kassassin, Ghazza, Senaar, Northern Etbai, mouth of Dinder Nile, Meadi), from Oran and Oued Nsa in the Algerian Sahara.

34. **Pyrgomorpha kraussi** sp. n. (Plate XLVIII, figs. 20, 21.)

Pyrgomorpha granulata Krauss, 1877 (*nec* Stål, 1875).

♀. Large, robustly built.

Antennae at the base slightly flattened, rounded-triangular in cross-section, but scarcely dilated, a little shorter than head and pronotum together.

Head as long as prozona of pronotum. Face in numerous, though not dense, round callous tubercles. Frontal ridge between antennae raised, with sharp margins and a deep, slightly dilated, sulcus, lower down the ridge is only faintly indicated, with interrupted subcallous margins and scarcely perceptible sulcus. Lateral facial keels subparallel in the upper portions down to the feeble transverse sulcus below the median ocellum, obtuse-angularly broken opposite the sulcus, and subparallel again, though much more distant from each other, in the rest. Fastigium of vertex distinctly longer than broad, somewhat constricted in the middle, slightly widened to the broadly rounded apex and suddenly dilated basally. Vertex convex, with numerous callous tubercles; its marginal carinae (*i.e.* inner margins of foveolae) with series of callous nodules; a sublateral series of four larger tubercles on each side; median carina very low, interrupted, but with numerous callous nodules. Cheeks with irregular double series of large, low

tubercles. Eyes broadly elliptic, their long diameter only a little exceeding the short one, not truncate behind.

Pronotum thick and broad, rugulose and punctured, especially in metazona, with numerous low callous tubercles. Disc of prozona rounded convex in the transverse direction, slightly so in longitudinal one. Transverse sulci distinct, the first one on the disc only. Metazona about two-thirds of the length of prozona; its disc practically flat, slightly concave anteriorly, trapezoidal, narrowed behind; hind margin obtuse-angulate, the angle rounded. Median keel scarcely perceptible as an irregular smooth line, entirely obliterate between sulci. Lateral keels replaced by series of few callous tubercles; in metazona there is only a pair of such tubercles, but its disc forms almost straight angles with the lateral lobes, and these shoulder ridges are prolonged on to the prozonal lobes where they go obliquely towards the lower anterior angle and are gradually obsolescent. Lateral lobes distinctly convex in prozona and very distinctly concave along the hind sulcus and in the adjoining part of metazona; lower margin with depressed confluent callous tubercles, scarcely sinuate; anterior angle very obtuse; posterior one briefly obliquely truncate, with a very small tooth-like tubercle before it.

Sternum about as broad as long. Mesosternal lobes strongly narrowed anteriorly; hind margin a little shorter than the length of the lobe; mesosternal interspace transverse, narrowed behind, its posterior width subequal to the distance from its anterior margin to the metasternal interspace; the latter as broad as the mesosternal one anteriorly.

Elytra extending slightly beyond the two basal thirds of the hind femora, very strongly dilated before the middle, three times as long as the maximum width; the apex narrowly parabolic.

All femora, as well as the front and middle tibiae and abdomen, in depressed callous tubercles.

Coloration yellowish-green; tubercles paler, especially the postocular series running on to the lower margin of the pronotal lobes. Elytra with the very base of radial veins brownish. Wings sanguineous, front margin and apex greenish.

♂ (*paratype*). Antennae triangular in section at the very base, cylindrical in the rest, distinctly longer than head and pronotum together. Fastigium of vertex much longer than broad, constricted behind the middle, strongly dilated at the base and towards the broadly rounded apex. Head and pronotum strongly granulate and tuberculate. The shoulder ridges of pronotum very distinct, strongly tuberculate. Lateral keels in prozona strongly tuberculate, convergent behind. Lateral lobes broadly sinuate below. Sternum

coarsely, but irregularly punctured. Mesosternal lobes distinctly longer than broad behind, hind angles acute, rounded apically. Mesosternal interspace slightly longer than it is wide anteriorly, narrowed behind. Metasternal interspace as broad as the mesosternal one behind. Elytra reaching a little beyond the hind knees, four times as long as their maximum width. Coloration dirty brown, with indefinite blackish dots. Postocular callous fascia paler.

Total length ♂ (paratype) 23·5, ♀ (type) 33; pronotum ♂ 5, ♀ 7; elytra ♂ 15, ♀ 15; hind femur ♂ 11, ♀ 14 mm.

Described after 8 ♂♂ and 8 ♀♀ from Azare, N. Nigeria (*Dr. Ll. Lloyd*); 1 ♂, 2 ♀♀ from Kulme, Darfur Province, British Sudan, viii.1921 (*Admiral H. Lynes*); 1 ♂ from Jantos, Ashanti, Gold Coast, 5.ii.1913 (*J. J. Simpson*); 1 ♀ from Kayima, Sierra Leone, 25.vi.1912 (*J. J. Simpson*); 1 ♀ from S. Nigeria (*Dr. S. A. Jones*); 1 ♀ from Gambia, 8.iii.1911 (*J. J. Simpson*).

This is the species which Krauss and other writers recorded from West Africa under the name *granulata* St. Since the latter species has been originally described from Damaraland, and the West African specimens seemed to me not entirely answering the diagnosis, I thought it necessary to compare them with Stål's type. Professor Y. Sjöstedt was kind enough to present the British Museum with a female co-type of *P. granulata* (in exchange for a female paratype of the new species), and it became clear to me that the West African insect resembles *P. granulata* only in the degree of development of elytra, but differs from it in a number of important characters.

The new species is only a little larger, but a much broader and heavier insect than *P. granulata*, the female of which is very slender when compared with *P. kraussi*. Antennae in *P. granulata* are longer and more compressed; face smooth, except for two small granules near clypeus, but frontal ridge distinct almost down to the clypeus; lateral facial keels, seen from the front, not angularly broken, but only sinuate; fastigium narrower and narrowed anteriorly, without a constriction; head and pronotum almost smooth; pronotum compressed laterally, keels very low, but distinct, shoulders of metazona rounded; mesosternal interspace more transverse; elytra of the female narrower, quite four times as long as their maximum width, and almost reaching hind knees.

The true *P. granulata* is known to me from the following localities: Damaraland (*Stal's co-type*); Boshof and Petrusburg, Orange Free State; Salisbury, Mashonaland; Mt. Chirinda, Gazaland.

I dedicate the new species to Dr. Hermann Krauss, one of the founders of modern orthopterology.

35. **Poecilocerus hieroglyphicus** (Kl.).

One male.

This is an essentially N.E. African species, known from Egypt, Sudan, Nubia and Somaliland, and its occurrence in the Northern Nigeria is of considerable interest, the more so that all other species of the genus are distributed only in Sudan, Egypt, Sinai, Abyssinia, Arabia and India.

36. **Hieroglyphus daganensis** Kr.

The only specimen, a male, of this species differs from the typical ones by the subgenital plate more narrow, not sulcate below and scarcely notched apically, and by the cerci armed with only a tubercle, not a short spine. Since, however, all other characters agree, I am not inclined to attach any importance to those differences which are, apparently, individual.

The species has been described from Dagana, Senegal, and recorded by me from Argungu, N. Nigeria, and from Tuburi Marsh, French Central Africa (see Bull. Entom. Res., xiii, 1922, p. 240).

37. **Hieroglyphus africanus** Uv.

One male.

Originally described from Atbara, Sudan, and Adamane in Kamerun (Bull. Entom. Res., xiii, 1922, p. 232); recorded also from the region of Niénébalé, French Sudan (P. Vayssière et J. Mimeur, Bull. Soc. Ent. France, 1924, No. 17, p. 189; the specimen has been identified by me).

Homoxyrrhepes gen. n.

Closely allied to *Oxyrrhepes* St., from which it differs in the following characters: Head thicker; fastigium of vertex about as long as broad; sides of fastigium very broad, coarsely punctured; face coarsely punctured. Pronotum without the lateral keels, broadly rounded

behind. Male cerci laminate, expanded in the apical half.

Genotype: *Heteracris punctipennis* Walk.

To this new genus belongs also *Oxyrrhepes virescens* St., described from Sierra Leone and known to me also from the region of Niénébalé, French Sudan, while Karsch, Krauss and Karny all recorded it from the respective localities around Nigeria.

38. **Homoxyrrhepes punctipennis** (Walk.).

One male.

This highly characteristic species has been described by Walker as *Heteracris punctipennis* and by I. Bolivar as *Oxyrrhepes elegans* (see my note on the synonymy in Trans. Ent. Soc. London [1924], 1925, p. 289) from Angola, and its occurrence in Northern Nigeria, Sierra Leone and N. Territories of the Gold Coast (British Museum collection) provides a very good example of a species distributed in the African savannas both south and north of the equator, while a connection between these two apparently separate regions through the grasslands of Eastern Central Africa can hardly be doubted.

39. **Leptacris pallida** (Burm.)?

One male.

The specimen agrees with the excellent description and figures by Krauss (*l.c.*), though one can never be certain whether this really is the species described by Burmeister in a couple of lines.

40. **Leptacris monteiroi** (Bol.).

One male.

The specimen does not differ perceptibly from one named so by I. Bolivar himself. Karsch (*l.c.* 1893, p. 114) recorded the species, originally described from Angola, from Togoland, and British Museum has specimens from Tanganyika Territory and British East Africa.

41. **Tristria sudanensis** Karny.

One male and three females.

The male genitalia agree with the figures given by Karny. The species has been known only from Sudan.

42. **Mesops laticornis** Kr.

Two males, four females.

It seems that Krauss was correct in regarding his *infuscatus* as a mere colour form of the species; I am inclined to think that the appearance of the dark basal area on the wings is in connection with the general dark coloration, but I would not state it quite positively until a more extensive series of specimens is available.

43. **Eucoptacra anguliflava** (Karsch).

Two males, five females.

Described from Bismarkburg in Togo.

44. **Epistaurus bolivari** Karny.

One male, one female.

Described from Gondokoro, Sudan.

45. **Phyxacra strenua** (Walk.).

Three males, one female.

It seems to me now that the characters which I have used to separate three known species of *Phyxacra* (Ann. & Mag. Nat. Hist., ser. 9, xi, 1923, p. 473) are neither constant nor sufficiently important to be considered specific, but to decide this problem more material must be studied from Sudang and N. Uganda. The Nigerian specimens belong, in any case, to *Ph. strenua*, though the type of the latter is a slightly smaller insect. The female is of the same pale-ochraceous general coloration as the type, but with some few blackish dots on pronotum and on the hind femora. Two of the males are of vinaceous-reddish colour, with the elytra irregularly banded; the third male is very strikingly coloured, its pronotum, pleurae, cheeks and the outer face of hind femora being pale-ochraceous, the rest of uniform, rather dark vinaceous colour, which appears also on the disc of pronotum in shape of a large semioval spot on prozona.

46. **Anacridium moestum melanorhodon** (Walk.).

One female.

47. **Ornithacris cyanea cavroisi** (Fin.).

Three males.

48. **Kraussaria angulifera** (Kr.).

One male.

Described originally from Senegal, but since then recorded from many localities in the savannas, from Gambia through Sudan and Erithraea to Arabia.

49. **Catantops stylifer** Kr.

A long series of specimens. The short black line at the middle of the upper outer carina of the hind femur is a very constant character, being absent in one specimen only from the whole lot; sometimes there is another, still shorter and finer black line on the same carina just before the narrowest part of the femur.

The species has been known from Ile de Piscis in Portuguese Guinea, Dubreka in the French Guiana, Bismarkburg in Togoland, Dagana in Senegal, and Gondokoro in N. Uganda; there are specimens in the British Museum from Mukongolo in Uganda, Gambia and Prang, Northern Territories, Gold Coast.

50. **Catantops praemonstrator** Karsch.

1893. *Catantops praemonstrator* Karsch, Berl. Ent. Ztschr. xxxviii, p. 95 (*nec* Karny 1907 !).

1907. *Catantops wernerellus* Karny, Sitzungsber. Akad. Wiss. Wien, Mat.-nat Kl., cxvi, Abt. i, p. 81 (*nov. syn.*).

Two females.

A careful comparison of specimens from the Gold Coast, Gambia and Nigeria with the original description of *C. praemonstrator* from Adeli, Togoland, and with specimens from Gondokoro, that is with topotypes of *C. wernerellus*, showed no appreciable differences. The Gondokoro specimens are only slightly more slender than the Western ones, but there is no difference in the male genitalia, and it is clear that Karny described his species as a new one simply because he mistook for *C. praemonstrator* some other species with spotted outer face of the hind femora (see Karny, *l.c.*, p. 55). Karsch himself mixed up his own species with *C. adustus* Walk. (= *C. urania* Kirby, see Trans. Ent. Soc. Lond. [1924] 1925, p. 297) from E. Africa when he recorded *C. praemonstrator* from Milanji, Nyasaland. *C. adustus* is certainly very near to *C. prae-*

monstrator and probably represents only a subspecies of it, there being no difference between them apart from the coloration of wings and of hind tibiae, but this is at least a good subspecific character.

51. **Catantops melanostictus** Schaum.

Five males, three females.

52. **Catantops haemorrhoidalis** Kr.

A long series of both sexes.

Previously known only from Dagana and Bissao in Senegal.

53. **Catantops annulatus** sp. n.

♂. Similar in the size and habitus to *C. melanostictus* Schaum.

Antennae thick, slightly depressed, longer than the head and pronotum together. Face very oblique, rugulose; frontal ridge broad, very slightly constricted below the ocellum and more distinctly at the fastigium, the surface coarsely punctured, feebly impressed below the ocellum. Vertex sloping, elongate-pyriform, feebly impressed; distance between the eyes equal to the width of antenna.

Pronotum more compressed laterally and more coarsely punctured and rugulose than in *C. melanostictus*. Transverse sulci deep, the last one distinctly behind the middle. Lateral lobes longer than deep, coarsely punctured throughout (even on the black spot which is only sparsely punctured in *C. melanostictus*), with the foveolae on their upper margin between the sulci very distinct. Mesopleurae and metapleurae coarsely and very densely punctured. Prosternal tubercle somewhat inclined backwards, cylindrical, a little inflated apically. Mesosternal interspace constricted before its middle, but its narrowest part as broad as the frontal ridge below the ocellum. Metasternal lobes connected by a long suture.

Elytra narrow, extending beyond the hind knees.

Hind femora more slender than in *C. melanostictus*, densely punctured above.

Supra-anal plate distinctly longer than broad, somewhat constricted before the middle, then widened again, then gradually and strongly narrowed towards the acute apex; its surface obtusely tectiform along the middle, with a median sulcus in the basal half. Cerci long, slender, distinctly incurved and recurved, tapering to the apices, which are briefly obliquely truncate, slightly decurved, and in most cases touching each other behind and above the apex

of the supra-anal plate. Subgenital plate compressed laterally, narrow conical.

General coloration brownish-grey mottled with grey, black and yellowish. Antennae dark-brown, with irregular pale rings which are broad above and very narrow, or obsolete, below. Face with brown punctures. Sides of fastigium below, orbits of eyes, broad interrupted postocular fasciae and an irregular median fascia along the occiput, black. Rest of the head yellowish. Pronotum with the disc brownish, paler along its sides; lateral lobes with an irregular black spot in prozona, reaching the front margin; metazona brown with indefinite blackish streaks; lower margin broadly yellowish, with a blackish spot at the median lower angle. Pleurae with the oblique pale fasciae less sharp than in *C. melanostictus*. Elytra grey, with numerous zigzaggy blackish transverse fasciae; discoidal field with a few blackish spots which are smaller than in *C. melanostictus* and not shining. Hind femur inwardly and below greenish-yellow; inner area with a subbasal spot above, a median fascia reaching down to the middle, a pre-apical fascia, and the base of the knee, black; upper inner area with the basal spot and three fasciae, brownish-black, not sharply defined; upper middle carina with a series of minute black dots; upper outer area with only very faint traces of two darkish fasciae; outer median area with an interrupted broad longitudinal fascia along the lower basal half, an oblique spot in the middle of the upper half, a large elongated spot in the apical third and a small spot at the knee-base, black, all these spots being of very irregular outlines and with many interruptions; upper outer carina with a few black dots; lower outer area with a black line along the middle and a row of large round black dots along each side of the line. Hind tibiae dirty greenish-blue, dotted with black, with the base yellowish. Abdomen dirty yellowish-green, heavily annulated above with greenish-black.

Total length ♂ (type) 22, ♀ (paratype) 26; pronotum ♂ 4, ♀ 6; elytra ♂ 17, ♀ 21; hind femora ♂ 10·5, ♀ 14 mm.

Described from 14 ♂♂ and 8 ♀♀.

This new *Catantops* is easily recognised by its annulated antennae and abdomen, while the irregular pattern of the outer face of hind femora is also highly peculiar. This pattern varies a good deal, the basal fascia sometimes joining with the upper median spot, but in all cases the fasciae and spots remain of irregular outlines and intersected with pale lines which often become so broad as to split up a fascia into a series of spots. The pattern of the

ower outer area is also very striking. Male cerci are much longer and more curved than in *C. haemorrhoidalis* and very different from those of *C. melanostictus*.

54. **Catantops minimus** Karny?

Three males, four females.

I cannot feel quite certain in my identification, because Karny described his species very briefly and after female specimens only which have possibly been discoloured, as well. The females before me now do not differ, however, from his description, except for the presence of pale sanguineous spots on the pronotal lobes, pleurae and sternum. On the other hand, the Nigerian specimens agree very well with *C. bipunctatus* Bol. from the Belgian Congo, differing from it in the smaller size and in the shape of the male cerci, which are simply incurved apically in the Congo species, while in the Nigerian one their apex presents a small recurved and incurved lobe; in some specimens one can see that this lobe is nothing but an upper branch of the bifurcate apex, the lower one (*i.e.* the true apex) being perceptible as a small tubercle which sometimes disappears altogether.

The measurements of the Nigerian insects are as follows : Total length ♂ 18–19, ♀ 23; pronotum ♂ 3·5–4, ♀ 5; elytra ♂ 16–17, ♀ 19·5; hind femur ♂ 9–10, ♀ 11·5 mm.

The black dots on the hind femora are not constant and in some specimens disappear altogether.

55. **Catantops plagiatus** sp. n.

Small and slender.

♂. Antennae thick, slightly compressed, distinctly longer than head and pronotum together.

Face strongly oblique, rugulose and bearing some depressed callous tubercles. Frontal ridge slightly concave in profile (*i.e.* projecting forward in its upper portion), slightly widened between antennae, deeply sulcate throughout, with the margins sharp, nodulose. Fastigium of vertex practically horizontal, forming an acute angle with the frontal ridge, elongate-pyriform in shape, the surface somewhat impressed, uneven, margins slightly raised, obtuse. Distance between the eyes not broader than antennae. Occiput with two pairs of depressed callous tubercles and similar interrupted lateral fasciae, irregularly punctured close to these callosities.

Cheeks with a broad callous subocular fascia and some small callous tubercles.

Pronotum cylindrical (with the metazona slightly thicker) punctured, callously-rugulose and with small, depressed callous tubercles. Median keel almost obliterated in prozona, very fine in metazona. Transverse sulci fine, but quite distinct; the hind one placed well behind the middle. Hind margin very obtusely angulate. Lateral lobes about half as long again as deep, strongly callously rugose, punctured (very densely in the metazona), with numerous small callous tubercles; lower margin with an obtuse, rounded angle, and a broad callous fascia. Pleurae densely punctured, with a few callosities. Prosternal tubercle narrowly conical, pointed, straight, but slightly inclined backwards. Mesosternal interspace *x*-shaped, the lobes touching each other in the middle; metasternal lobes connected along a straight line.

Elytra extending slightly beyond the hind knees and the apex of abdomen.

Hind femora slender, bearing numerous depressed round callosities on the oblique ridges of the externo-median area, as well as along the carinae.

Supra-anal plate elongate heart-shaped, not more than half as long again as broad, with a broad shallow sulcus along the basal half. Cerci not much longer than supra-anal plate, very slightly incurved, compressed laterally at the base, gradually tapering apically, with a very short, obtusely conical inner branch (almost a tubercle) before the apex.

Coloration reddish-brown. Antennae darker basally, with narrow pale rings at the apex of each segment. Callosities on the head, thorax and hind femora pale yellowish, except the broad lower lateral fascia, which is old ivory white. Lateral lobes of pronotum and pleurae with indefinite sanguineous markings. Elytra brownish. Wings faintly infumate. Hind femora pale olivaceous. Hind tibiae pale olivaceous, turning somewhat sanguineous in the apical third.

♀ (*paratype*). Mesosternal lobes only very narrowly separated in the middle. Metasternal interspace linear, narrower than an antenna. Hind femur with a blackish dot externally, before the apex.

Total length ♂ 20–23, ♀ 26–28; pronotum ♂ 4·5–5, ♀ 5–6; elytra ♂ 15–16, ♀ 18·5–19·5; hind femur ♂ 9·5–11, ♀ 11·5–12·5 mm. (the lowest figures for the male represent the measurements of the type).

Described after 4 ♂♂ and 2 ♀♀.

The general coloration is sometimes paler than in the type and then the pale callosities become less conspicuous. Apart from the blackish dot on the outer face of femora, as described in the female, there may be another, just opposite it on the inner area, but sometimes they both disappear.

The species may possibly be referred to the genus *Catantopsis* Bol. owing to its very slender habitus, but I do not know the type of that genus in nature.

56. **Tylotropidius gaugeri** Schulth.

A long series of specimens in the Nigerian collection shows that this species varies considerably in the coloration, which becomes sometimes quite uniform reddish-brown (one male): the lateral keels of pronotum are mostly pale, but not seldom they do not differ in colour from the rest of the disc, which sometimes bears two pairs of blackish spots (one male): in one female the pronotum is somewhat greenish. The shape of lateral pronotal keels is fairly constant, though they are not always quite straight, but may become somewhat convex.

The species has been described from Accra, Gold Coast.

57. **Acorypha picta** (Kr.).

1877. *Acorypha picta* Krauss, *l.c.* p. 11, pl. i, fig. 4, 4A–C.

A very long series of specimens of both sexes convinces me definitely that the genus *Acorypha* Krauss has been founded on a somewhat aberrant species of *Caloptenopsis*. Moreover, the type of *Acorypha picta* was an aberrant specimen of the species, as it is obvious from the study of the specimens before me. Most of the specimens are quite typical for the genus *Caloptenopsis*, but there is a good deal of variation in the shape of pronotum, which in certain specimens is distinctly constricted in prozona, with the lateral keels somewhat inflexed, and the median keel high, sometimes even quite tectiform; in the latter case the insect acquires a general habitus considerably different from other species of the genus. There is not the slightest doubt, however, that these are but individual variations and the aberrant specimens cannot be separated even specifically, much less generically, from the normal ones, with which they are connected by intermediate forms. Thus the following generic synonymy must be

established: *Acorypha*, Krauss 1877 = *Caloptenopsis* Bol. 1889 (*syn. nov.*).

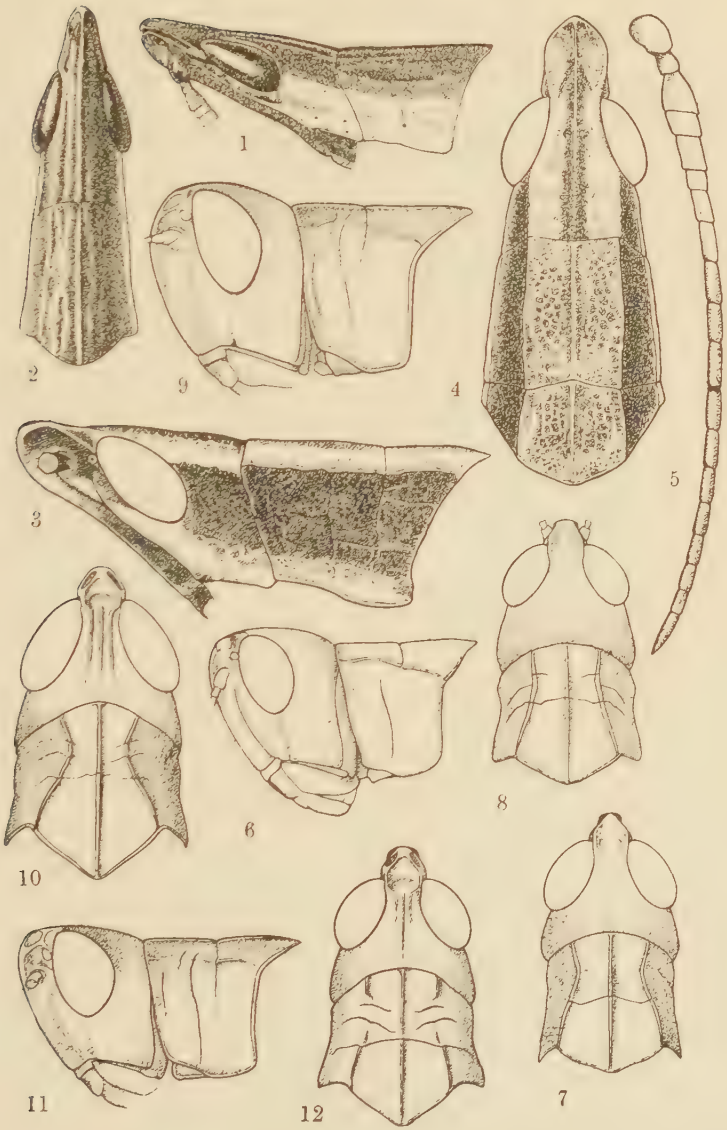
The description by Krauss fits the Nigerian specimens quite well, except in some minor details in coloration which are of hardly any value in this genus. The specimens with the "normal" pronotum are similar to *C. pallidicornis* St. from S.E. Africa, but belong to a different group by the structure of the inner tibial spurs (division 8 in my key to species, Trans. Ent. Soc. London, 1922, p. 134). Another species, *Caloptenopsis unicarinatus*, described by Krauss also from St. Louis, Senegal, differs from *A. picta* by the structure of fastigium, which in *A. picta* is sulcate in both sexes while in *C. unicarinatus* it is scarcely impressed even in the female; apart from that, *C. unicarinatus* has the pronotum little narrowed anteriorly, with the prozona almost equal to metazona (much shorter in *A. picta*) and the lateral keels are almost entirely obliterate, which happens in the specimens of *A. picta* with the high median carina; the inner area of hind femora is without markings in *A. picta*, while it is almost wholly black in *C. unicarinatus*.

58. **Acorypha glaucopsis** (Walk.).

One female.

I could not be certain in my identification of this insect, which I was inclined to take for *Calliptamus italicus* L., but a good series of both sexes, collected by M. Mimeur at Reçu, French Senegal, and sent to me by Dr. Vayssière enabled me to get the correct name. The females of this species are very similar to those of *C. italicus*, differing mainly by the somewhat (not at all strongly) elongated inner tibial spurs, but the males can be easily recognised by the shape of the cerci which bear a single black tooth below the apical lobe, instead of two teeth as in *C. italicus*; the deep sanguineous-black coloration of the inner face of the hind femora and an oblique ridge on the pronotal lobes supply further characters separating *A. glaucopsis* from *C. italicus*.

A. glaucopsis has so far been known from India only, and its occurrence in the savannas of Africa is very important from the zoogeographical point of view. The distribution of the species in Africa is, of course, not sufficiently known, but I know it from Khartoum, as well;



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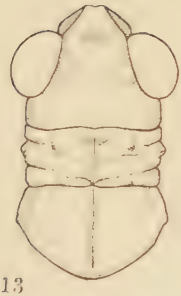

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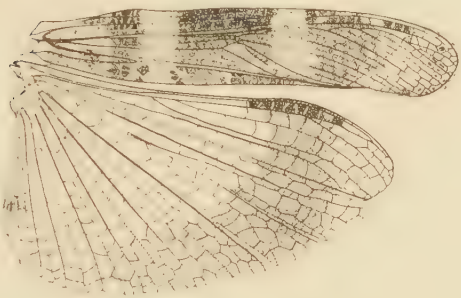

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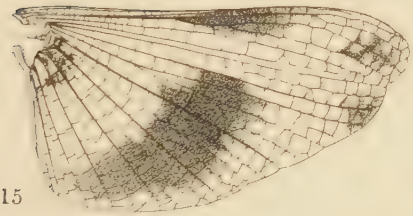

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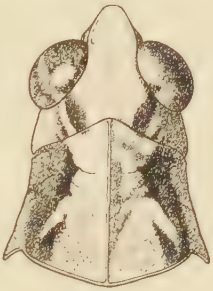

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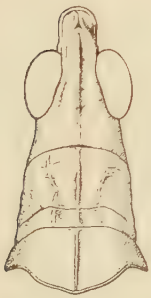

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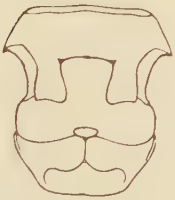

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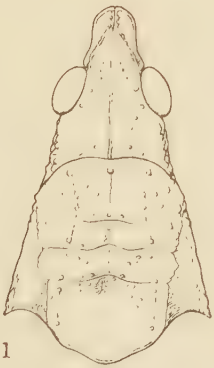

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Karny's record of *C. italicus* from the latter locality, as well as that by Vayssière from Senegal (Bull. Soc. Ent. France, 1924, p. 189; my preliminary identification), must be referred to *A. glaucopsis*, the occurrence of *C. italicus* south of Sahara being very unlikely.

Explanation of the Plates.

PLATE XLVII.

Figs. 1, 2. *Azarea lloydi*, gen. and sp. n. ♂.
3, 4, 5. *Sherifuria haningtoni*, gen. and sp. n., ♂.
6, 7. *Stenohippus xanthus* (Karny), ♀.
8. ,, *aequus*, sp. n., ♀.
9, 10. *Aulacobothrus wernerianus* (Karny), ♀.
11, 12. ,, *punctatus*, sp. n., ♀.

PLATE XLVIII.

Figs. 13, 14. *Lerina nigerica*, sp. n., ♂.
15, 16. *Oedaleus nigeriensis*, sp. n., ♂.
17, 18, 19. *Pyrgomorpha cognata*, Krauss, ♂.
20. ,, *kraussi*, sp. n., ♂.
21. ,, ,, ,, ♀.

Figures 14 and 15 magnified three times, the rest six times.

XVIII. *The Butterflies of Jamaica.* By W. J. Kaye.

[Read October 21st, 1925.]

The tropical island of Jamaica is to a lepidopterist very disappointing. For an island of 4207 square miles, being 144 long and 49 wide, and lying between the latitudes 17° 45′ and 18° 35′ N., the paucity of the butterfly fauna is remarkable. In the eastern half of the island there is the large mountain area of the Blue Mountain range, which ascends to 7360 ft. and which averages 2000 ft. Some 60 square miles have an altitude of 4000 ft. and upwards. From this it will be seen that there is plenty of variety of altitude. There is also a very varied vegetation, and in the mountains even a luxuriant vegetation, especially on the moist northern slope. Severe droughts are almost unknown, but hurricanes occur once or twice in a decade, and doubtless take a large toll of the butterfly life. It seems clear that as the conditions appear so eminently suitable for a large butterfly fauna, Jamaica could never have supported a large number of species. It is possible that a number of species may have died out, though from what cause or causes must remain a mystery. Jamaica's near neighbour, Cuba, although many times the size of Jamaica, being over 750 miles long and 50 miles wide, has but 145 species, an almost equally poor showing considering the difference in area of the two islands. As Central America is so exceptionally rich in species it is remarkable that so many common species of the mainland should be entirely unrepresented. The dominant subfamily of the mainland, the Ithomiinae, containing many of the most abundant species on the mainland, has but one insignificant representative in Jamaica, *Hymenitis diaphanus*. Another remarkable case is that there is no representative of the numerous family Erycinidae, as is the case in Cuba. Then in the Heliconidae there is only one representative, *Heliconius charithonia charithonia*. The non-appearance of either some *melpomene*-form or some *erato*-form is specially remarkable, seeing that both of these are found everywhere on the mainland from sea-level up to five or six thousand feet altitude. Also there is no representative of *Eueides*,

although Cuba can show *Eueides cleobaea*. Jamaica may still hold some form of this genus that yet remains to be discovered. Again, with *Lycorea* there is no representative, although Cuba produces *Lycorea ceres demeter*, and Haiti *Lycorea ceres cleobaea*. With such a large conspicuous insect it is hardly possible that one could have overlooked any *Lycorea* in Jamaica, and we must suppose any pre-existing form has died out. Perhaps the most astonishing feature of the Jamaican (as also the Cuban) butterfly fauna is the fact that there is only one species of the family Satyridae—*Calisto zangis*—and that one is peculiar to the island and belongs to a genus—*Calisto*—wholly confined to the Greater Antilles. That there should neither be any representatives of *Neonympha, Coenonympha, Erebia* and *Satyrus* of the North American fauna, nor of *Euptychia, Taygetis* and *Pierella* of the Central and South American faunas is specially striking. Feeble flight alone cannot account for the absence of these forms, as in spite of hurricanes weak-flying *Terias* are to be found commonly.

In the Papilionidae, Jamaica has 6 species of *Papilio* to 13 of Cuba and 9 of Hispaniola, but while six may be held to be a fair representation, it compares with 38 species that have been recorded from Honduras, a country roughly the area of Cuba. In the Pierinae 13 species have been found, and except for one little distinct species of *Terias—adamsi*—none is peculiar to the island. One would certainly have expected a representative of *Daptonoura, Meganostoma* and *Dismorphia*, all of which genera are found in Hispaniola. The presence in the latter island of a mimetic *Dismorphia—spio*—is puzzling from the fact that it has no Ithomiine or other model to gain protection from. Again *Catopsilia* is represented in Jamaica by only the 3 species *eubule, argante* and *statira*, although in Cuba and Hispaniola there are *avellaneda* and *thalestris* representing *philea* of the mainland as well as *orbis* and *trite*. The common *Terias proterpia* is absent also. *Terias pyro* of Hispaniola is probably the representative of *T. messalina* of Jamaica and Cuba.

In the Lycaenidae 10 species seems remarkably poor, and it is highly probable that further species will be added. In the Hesperidae there are all told 28 species, 18 belonging to the Hesperiinae and 10 to the Pamphilinae. Thus the Skippers form one-third of the known butterflies, which number no more than 91 species. The representative of

the Libytheidae is *Libythea terena*, which is also found in Cuba. There are 3 true Danaines, which is one of the few instances where Jamaica can show richness. The occurrence of *Danais cleophile*, a species confined to Cuba, Haiti and Jamaica, in addition to *Danais plexippus* and *Danais gilippus*, is noteworthy. There is no possible doubt that we have 3 species and that *D. cleophile* is quite distinct and occurs at times with *D. plexippus*.

Botanically Jamaica is very rich, especially in the ferns, having no less than 473 species. Of the trees there are Mahogany, Cedar, Logwood, Mahoe, Yacca, Satinwood, Cyp and Balata. Of fruit-bearing trees there are the Cassava, Mammee, Guava, Naseberry, and Pawpaw. Of native flowers that attract one's attention mention can be made of Anotto with rose-coloured flowers and purplish pods; the West Indian Ebony with its yellow flowers which Cundall says burst into bloom after almost every shower: the pale blue of the lignum-vitae bloom; the golden bronze of the under surface of the leaves of the star-apple tree: the hanging purple branches of the bastard cabbage-bark tree; the yellow and purple portulacas; the yellow kill-buckra weed, now commonly called Jamaica buttercup, seen in great profusion in the plains about Christmas time; the pink shameweed; the red and yellow of the Barbadoes pride (*Caesalpinia pulcherrima*); the yellow of the Jerusalem thorn; the purple pyramid of the mountain pride, all help to lend colour to the gardens, while there is an abundance of herbage on all waste land. In all, there are upwards of 3000 species of flowering plants known and described, but often the absence of butterfly life strikes the naturalist as exceptional.

There is an aspect bearing on the Jamaican fauna that is at once both interesting and remarkable. Jamaica is in many respects more like Cuba in its lepidopterous fauna, yet a deep sea of between 2000 and 3000 fathoms divides the two islands, while a series of submerged islands covered by only 100 fathoms of water occur between Jamaica and the mainland of Honduras, and nowhere is there a greater depth than 1000 fathoms and for the greater part a very great deal less. Between Jamaica and Haiti, again, there is a deep sea, but less deep than between Jamaica and Cuba. Between the two former there is a depth of between 1000 and 2000 fathoms. Yet Haiti has many affinities with Jamaica, and faunistically the three islands—Cuba,

Haiti, Jamaica—are far more like one another than either is to the mainland. The Satyrid genus *Calisto* is represented only in the Antilles and is absent on the mainland. The Nymphaline genus *Lucinia* also is only found in the three Greater Antilles. The small *Phyciodes pelops* is represented on all three islands, but is absent on the mainland. In Jamaica there is a second species, *proclea*, that is confined to the island. Both *pelops* and *proclea* are quite removed from any mainland forms by the presence of an inner marginal tuft of hair in the male sex. Several species, although different in all the islands, can be traced to mainland forms such as *Papilio celadon* in Cuba, *Papilio zonaria* in Haiti, and *Papilio marcellinus* (= *sinon*) in Jamaica, all of which can be supposed to have originated from *Papilio philolaus* of Central America. *Papilio thersites*, which is peculiar to Jamaica, is no doubt derived from *Papilio lycophron*, which occurs throughout Central America. *Papilio homerus* of Jamaica, which is closest to *Papilio machaonides* of Haiti, is, like that species, unrepresented in either Cuba or the mainland. *Papilio pelaus* is, again, only found in the Antilles, including Porto Rico, but not on the mainland. *Adelpha abyla*, like *Adelpha basilea* from Cuba, can be looked upon as a development of *Adelpha iphicla* of the mainland. *Cystineura dorcas* is an isolated production in Jamaica not very closely related apparently to any other species, although clearly belonging to the widely spread genus *Cystineura*. This genus is most curiously not represented in Cuba.

A curious feature of the Jamaican butterfly fauna is that there is no mimicry between the families and genera as we know it on the mainland of Central and South America. The primary models, the Ithomiinae, are practically non-existent except for the small and insignificant *Hymenitis diaphanus*. The absence of even any species of *Mechanitis*, *Hirsutis* or *Ceratinia* is certainly remarkable, and may account for the absence of so many species of *Heliconius* and other genera nearly always in association with the Ithomiinae. But again, with the Papilioninae, although there are representatives of all three divisions of *Papilio*, there is no mimicry between them, for one cannot consider that *Papilio thersites* is a mimic of *Papilio thoas melonius*, as these both belong to the second group, although it is true they are often found together.

Although in both number of species and in the numbers

of specimens Jamaica is but poorly represented, the number of distinct species is rather large. No less than 14 species are wholly confined to the island. They are the following :—

Papilio homerus.	Papilionidae.
,, *thersites.*	,,
,, *marcellinus.*	,,
Terias adamsi.	,, (Pierinae).
Hymenitis diaphanus.	Danaidae (Ithomiinae).
Phyciodes proclea.	Nymphalidae.
Chlosyne pantoni.	,,
Cystineura dorcas.	,,
Lucinia cadma.	,,
Adelpha abyla.	,,
Calisto zangis.	Satyridae.
Theda pan.	Lycaenidae.
Limochores insolita.	Hesperidae.
Rhinthon thermae.	,,

In addition to these there are distinct subspecific forms of another 10 species.

Papilio thoas melonius.	Papilionidae.
,, *polydamas jamaicensis.*	,,
Eunica tatila tatilista.	Nymphalidae.
Phyciodes pelops aegon.	,,
Anaea troglodyta troglodyta.	,,
Kricogonia castalia castalia.	Pierinae.
Pieris amaryllis amaryllis.	,,
Glutophrissa drusilla jacksoni.	,,
Terias dina parvumbra.	,,
Pyrrhocalles antiqua jamaicensis.	Hesperidae.

There are 8 species that are also to be found in Cuba and Hispaniola, but which are absent from the mainland. These are the following :—

Papilio pelaus.	Papilionidae.
Danais cleophile.	Danaidae.
Phyciodes pelops.	Nymphalidae.
Dynamine zetes.	,,
Hypanartia paullus.	,,
Thecla crethona.	Lycaenidae.
Callicista columella.	,,
Pyrrhocalles antiqua.	Hesperidae.

The small Nymphaline *Dynamine zetes* and the equally small *Terias messalina* occur in Cuba and Jamaica, but apparently not in Hispaniola. Then with a more Eastern distribution there is *Libythea terena*, which occurs in Cuba, Haiti and Porto Rico, while *Libythea fulvescens* from Dominica might easily be the same species. It will be seen that, all told, there are 25 species that are not found on the mainland, while 66 or 72% do belong, even if in an altered form.

Of the 91 species inhabiting Jamaica 65 are also to be found in Cuba, giving a percentage of 71% as compared with 72% that are to be found on the mainland. But it is extremely probable that many Hesperidae found in Jamaica will also be found in Cuba, which would give a percentage which would exceed the mainland.

Systematic List of Jamaican Butterflies.

Family DANAIDAE.

Subfamily *DANAINAE*.

Danais plexippus erippus Cram.
Danais gilippus jamaicensis Bates.
Danais cleophile. Godt.

Subfamily *ITHOMIINAE*.

Hymenitis diaphanus Drury.

Family HELICONIDAE.

Heliconius charithonia charithonia Linn.

Family NYMPHALIDAE.

Subfamily *NYMPHALINAE*.

Colaenis julia delila Fab.
Dione vanillae Linn.
Phyciodes pelops aegon Fab.
Phyciodes proclea Dbl. Herv.
Phyciodes frisia Poey.
Chlosyne pantoni Kaye.
Pyrameis virginiensis huntera Fab.
Pyrameis cardui Linn.
Junonia lavinia coenia Hüb.

Anartia jatrophae jamaicensis Moesch.
Cystineura dorcas Fab.
Megalura chiron Fab.
Aganisthos odius orion Fab.
Coea cadmus Cram.
Gynaecia dirce Linn.
Lucinia cadma Dru.
Eunica tatila tatilista Kaye.
Eunica monima monima Cram.
Dynamine zetes Mén.
Adelpha abyla Hew.
Anaea troglodyta troglodyta Fab.
Anaea glycerium Dbl. Hew.
Hypanartia paullus Fab.
Victorina stelenes lavinia Fab.
Euptoieta hegesia Cram.

Family ERYCINIDAE.

Subfamily *LIBYTHEINAE*

Libythea terena Godt.

Family SATYRIDAE.

Calisto zangis Fab.

Family PAPILIONIDAE.

Subfamily *PIERINAE*.

Catopsilia eubule Linn.
Catopsilia argante agarithe Fab.
Catopsilia statira Cram.
Kricogonia castalia castalia Fab.
Gonepteryx maerula Fab.
Terias elathea Cram.
Terias adamsi Lathy.
Terias messalina Linn.
Terias westwoodi westwoodi Bdv.
Terias euterpe Mén.
Nathalis iole Bois.
Pieris amaryllis amaryllis Fab.
Pieris monuste virginia Röb.
Glutophrissa drusilla jacksoni Kaye.

Subfamily *PAPILIONINAE*.

Papilio polydamas jamaicensis Roths. & Jord.
Papilio thoas melonius Roths. & Jord.
Papilio thersites Fab.
Papilio pelaus pelaus Fab.
Papilio homerus Fab.
Papilio marcellinus Dbl.

Family LYCAENIDAE.

Thecla simaethis Dru.
Thecla crethona Hew.
Thecla telea Hew.
Thecla pan Dru.
Callicista bubastus Cram.
Callicista columella Fab.
Callipsyche thius Hüb.
Eupsyche acis Dru.
Leptotes cassius Cram.
Chilades hanno Stoll.

Family HESPERIDAE.

Subfamily *HESPERIINAE*.

Eudamus proteus Linn.
Eudamus catillus Cram.
Telegonus anaphus hahneli Stgr.
Telegonus creteus jaira Butl.
Proteides idas Cram.
Epargyreus antaeus Hew.
Acolastus amyntas Fab.
Ephyriades otreus jamaicensis Moesch.
Cabares potrillo Lucas.
Pellicia bromias Godm. & Salv.
Echelatus simplicior Plötz.
Grais stigmaticus Mab.
Eantis thraso Hüb.
Timochares ruptifasciata Plötz.
Chiomara gesta Hew.-Sch.
Rhinthon thermae Kaye.
Heliopetes arsalte Linn.
Hesperia syrichtus Fab.

Subfamily *PAMPHILINAE.*

Catia vesuria Plötz.
Hylephila phylaeus Dru.
Thymelicus vibex Huebn.
Limochores insolita Butl.
Calpodes ethlius Cram.
Prenes ares Feld.
Prenes nero fufidia Hew.
Pyrrhocalles antiqua jamaicensis Schs.
Morys valerius Moesch.
Cymaenes silius Latr.
Perichares corydon Fab.

Family DANAIDAE.

Subfamily *DANAINAE.*

1. Danais plexippus erippus.

Papilio plexippus Linn., Syst. Ent., 1, p. 767; Cram., Pap. Ex., t. 206, f. E, F.
Papilio archippus Fab., Ent. Syst., iii, p. 49.
Danais archippus Godt., Enc. Méth., ix, p. 184; Butl. & Druce, P.Z.S., 1874, p. 330; G. & S., Biol. Cent.-Am. Rhop., i, p. 1 (1879); Haensch in Seitz, Macrolep., v, p. 113.
Danais erippus Cram., Pap. Ex., i, p. 4; Haensch in Seitz, *l.c.*, p. 1.

Range of species. Canada to Paraguay.
Range of subspecies. S. America, West Indies, Trinidad, Cuba, Hispaniola.

Not very common. Widely spread all over the island. Godman and Salvin took this species in company with *D. cleophile* at Moneague.

In Jamaican (and Haitian) specimens the usual white spots in the apex are more often than not yellowish. This is an interesting fact, seeing that *D. cleophile* is a species that always has yellow apical spots.

2. Danais gilippus jamaicensis.

Papilio gilippus Cram., Pap. Ex., i, t. 26, f. E, F. (1775).
Danais jamaicensis Bates, Ent. Mo. Mag., i, p. 33 note (1864); Godt., Enc. Méth., ix, p. 185, n. 32 (1819); Dbl. Hew., Gen. D.L., t. 12, f. 3 (1847); Moesch., Beitr. Schmett. Jam., p. 27.

Danais gilippus var. *jamaicensis* Moesch., *l.c.* (1886).
Danais cleothera Godt., Enc. Méth., ix, p. 185; G. & S., Biol. Cent.-Am. Rhop., 1, p. 3.

Range of species. Southern U.S.A. to S. Brazil, West Indies, Cuba, Hispaniola.

Range of subspecies. Jamaica.

Not very common. Decidedly local, but found in many parts of the island. Moneague, Montego Bay, Port Antonio, Kingston.

Larva on *Asclepias curassavica.*

3. Danais cleophile.

Danais cleophile Godt., Enc. Méth., ix, p. 185; Haensch in Seitz, Macrolep., v, p. 118.

Range. Cuba, Hispaniola, Jamaica.

Records from Jamaica are scarce, but in Haiti or rather Saint Domingo, on the north side, Mr. A. Hall found the species only at or over 1000 ft. At La Cumbre, 1600 ft., he met with several specimens in June 1922. Moneague (*Godman and Salvin*).

In Jamaica the species is now certainly very local and scarce, and I have seen no specimens that have been taken at all in recent years. The species is a most interesting one, as having such a limited distribution. There is no question of the species being quite distinct from any other.

Subfamily *ITHOMIINAE.*

4. Hymenitis diaphanus.

Papilio diaphanus, Dru., Ill. Ex. Ent., ii, t. 7, f. 3 (1773).
Hymenitis diaphanus Haensch in Seitz, Macrolep., v, p. 164.

Range. Confined to Jamaica.

A local species, and like so many of the Ithomiinae exceedingly abundant in favourite spots. Closely related species (?) occur in Cuba, Hispaniola and Ecuador. Commonest at the eastern end of the Blue Mountains, Rio Grande, Bath, Moore Town. On the wing in November, January, February, March, June, and occurring up to at least 3700 ft.

A special interest attaches to this butterfly as the sole representative of the immense subfamily Ithomiinae within the island. It is certainly strange that no *Mecha-*

nitis, *Dircenna* or *Pteronymia* should be found, as species of all these genera are exceedingly common practically throughout Central America.

Family HELICONIDAE.

5. Heliconius charithonia charithonia.

Papilio charithonia Linn., Syst. Nat., 1, 2, p. 757, n. 65 (1767).
Heliconius charithonia Riff., Gatt. Hel., p. 147 (1901); Moesch., Beitr. Schmett. Jam., p. 27 (1886).
Heliconius charithonia charithonia Stich. & Riff. in Tierr., 22, p. 214 (1905).
Heliconius charithonia Seitz, Macrolep., v, p. 394, Pl. 79*a*; G. & S., Biol. Cent.-Am. Rhop., 1, p. 151.

Range of species. Gulf States of U.S.A. to Venezuela, Colombia and Peru, Cuba, Hispaniola.

Range of subspecies. As above without Peru.

A very common butterfly flying along roads such as the Bog Walk where there is cover on either side. It is partial to open places where vegetation is not too dense. It is said by Haensch to occur in Ecuador up to 2500 ft., and I have taken many at Caracas at and over 3000 ft.; but in Jamaica it is decidedly a lowland species.

This is the only species of *Heliconius* belonging to Jamaica. *H. sapho* has been recorded, but as the species has its home in Colombia and Panama this was obviously an error. It is decidedly strange that no form of *cydno*, *melpomene*, or *erato* should be found as the genus *Heliconius* is so essentially a tropical American genus. Cuba also can show no other *Heliconius* species than *charithonia*.

Family NYMPHALIDAE.

Subfamily *NYMPHALINAE*.

6. Colaenis julia delila.

Papilio julia Fab., Syst. Ent., p. 509, n. 281 (1775).
Colaenis julia Moesch., Sch. fauna Jam., p. 27 (1886).
Colaenis julia delila Seitz, Macrolep., v, p. 480.
Papilio delila Fab., Syst. Ent., p. 510, n. 2821 (1775).
Colaenis delila G. & S., Biol. Cent.-Am. Rhop., i, p. 168 (1882).

Range of species. Texas to Paraguay, West Indies, Hispaniola, Cuba, Trinidad.

Range of subspecies. Central America, West Indies, but not Cuba.

A very common butterfly in Jamaica and flies the whole year round. Not ascending any great altitude and most common close to sea-level.

"Larva pale grey or grey-brown, the incisions darker, the fore part of the head marked with darker, the spines blackish; on *Passiflora vespertilionis*, *P. ichthyura*, etc. Pupa, . . . pale grey or pale yellowish-brown with whitish projections and darker markings."

7. Dione vanillae.

Papilio vanillae Linn., Mus. Ulr., p. 306 (1764).
Agraulis vanillae G. & S., Biol. Cent.-Am. Rhop., i, p. 171.
Dione vanillae, Butl. & Druce, P.Z.S., 1874, p. 350; Seitz, Macrolep., v, p. 401.

Range. Southern States, West Indies, Trinidad, Hispaniola, Cuba. Central America to the Argentine.

An abundant species. Jamaican specimens often run rather small.

Larva on *Passiflorae.* Colour leaden with white stripe on sides. Six light red lines along back and sides and two black thorny spines behind head (*W. Buthn*).

8. Phyciodes pelops aegon.

Papilio pelops Dru., Ill. Ex. Ent., i, t. 19, f. 35 (1773).
Phyciodes pelops Röb. in Seitz, v, p. 437.
Erycina aedon (misprint *aegon*) Godt., Enc. Méth., ix, p. 587, n. 111 (1819).
Argynnis pygmaea Godt., Enc. Méth., ix, p. 290, n. 63 (1819).
Papilio aegon Fab., Spec. Ins., ii, p. 130, n. 594 (1781); Moesch., Beitr. Schmett. Jam., p. 27 (1886).
Melitaea anocaona H. S., Corres. Blatt. Regens, 1844, p. 162, n. 18.

Range of species. Jamaica, Hispaniola, Porto Rico, Cuba.

Range of subspecies. Jamaica.

Quite distinct from *proclea* Dbl. Hew. Apex not black and with no white dot. A smaller species with rather more rounded wing than *proclea.* Underside as variable

as the companion species, but on the whole lighter with the markings more distinct.

A very rare species. The only recent captures were two specimens in the Blue Mountain foot-hills at 500 ft., in Nov. 1919, by Dr. F. W. Jackson. Probably very local and its proper habitat not yet discovered. The next following species is not at all rare in its special habitats, but is excessively local.

9. Phyciodes proclea.

Melitaea proclea Dbl. Hew., Gen. D.L., t. 23, f. 4 (1847).
Phyciodes proclea Kirby, Cat., p. 174 (1871); Kaye, Ent. Rec., xi, p. 147 (1899).

Range. Jamaica.

This little butterfly is locally fairly plentiful in the region of the Blue Mountain from 100 ft. up to 2700 ft. It is probably commonest at from 700-800 ft. in the counties of Portland and St. Thomas. The species is on the wing in July, August, September and December, and perhaps other months as well.

Cuna Cuna Pass, summit, in Aug. 1898 (*W. J. Kaye*). Neighbourhood of Moore Town plentiful. Rare in Gordon Town district. Foot of John Crow Mountains, sea-level, July 1925 (*F. W. Jackson*).

P. proclea is at once separable from *aegon* by having a black apex, within which is a clear white dot.

10. Phyciodes frisia.

Phyciodes frisia, Poey, Cent. Lep. Ent., p. 9; Röb. in Seitz Macrolep., v, p. 437, Pl. 89*e* (1913).
Eresia gyges Hew., Ex. Butt., iii; Eres., t. 6, f. 45, 46 (1864).
Phyciodes frisia G. & S., Biol. Cent.-Am. Rhop., i, p. 203 (part).

Habitat. Cuba, Hispaniola, Bahamas, Nassau.

A common little roadside butterfly occurring probably in every month of the year. Usually a low-level species, where it is certainly commonest, but occasionally ascending up to 2000 ft., where it has been secured above Gordon Town by Dr. F. W. Jackson. The true *P. frisia* does not occur outside the West Indian Islands. Godman and Salvin record the species from Florida, Panama, Colombia and

Venezuela, but it is doubtful if all these forms belong to one species.

11. Chlosyne pantoni.

Chlosyne pantoni Kaye, Entom., xxxix, p. 52 (1906), Pl. ii, f. 6.
Chlosyne pantoni Kaye, Entom., xlv, p. 150 (1912).
Chlosyne seitzi Röb. in Seitz, vol. v, p. 453 (1914), Pl. 91, f. L.

Range. Jamaica.

This exceedingly rare species has only been taken two or three times at long intervals. It was originally taken by Mr. E. S. Panton, but exactly where I have no knowledge except that it was in the Manchester Mountains. The specimen was handed to me by Mr. C. B. Taylor in 1898. In January 1911 Miss E. M. Fountaine took a fine specimen in wooded country at Troy on the edge of the cockpit country. As Troy is a good long way from the nearest point of the Manchester Mountain the species is evidently spread over a considerable area. As all the species of *Chlosyne* are rather local (especially the nearest relative *Ch. perezi* in Cuba) the present species may yet be found in some numbers.

12. Pyrameis virginiensis huntera.

Papilio huntera Fab., Syst. Ent., p. 499, No. 240 (1775).
Pyrameis huntera Seitz, Macrolep., v, p. 459 (1917).
Papilio cardui virginiensis, Dru., Ill. Ex. Ent., 1, t. 5, f. 1 (1773).
Pyrameis huntera G. & S., Biol. Cent.-Am. Rhop., i, p. 218.

Range of species. N. America to Argentina, Hispaniola, Cuba, Canary Isles, Sandwich Isles.

Range of subspecies. Tropical America.

Rare in Jamaica, and usually at between 4000 and 5000 ft. Mt. St. Catharine, Oct. 1919. Greenwich, Christmas 1919 (*F. W. Jackson*).

13. Pyrameis cardui.

Papilio cardui Linn., Faun. Suec., p. 276, No. 1054 (1761).
Pyrameis cardui Seitz, Macrolep., v, p. 458 (1914); G. & S., Biol. Cent.-Am. Rhop., 1, p. 217.

Range. All over the Old World and spreading from North America southwards as far as Trinidad. Cuba.

Rare in Jamaica and probably only a migrant.

14. Junonia lavinia coenia.

Junonia lavinia coenia Hübn., Samm. Ex. Sch. (1816-24).
Papilio lavinia Cram., Pap. Ex., i, t. 21, f. C, D (1775).
Junonia coenia G. & S., Biol. Cent.-Am. Rhop., i, p. 220.
Precis lavinia coenia Seitz, Macrolep., v, p. 461.

Range of species. Southern U.S.A. to Argentina, Hispaniola, Cuba, Trinidad.

Range of subspecies. Southern U.S.A., Central America and larger West Indian Islands, Colombia.

A common species most probably varying with the seasons as is found in other species (cf. *Precis*) in the Old World.

15. Anartia jatrophae jamaicensis.

Papilio jatrophae Linn., Syst. Nat., 1, p. 778 (1758).
Anartia jatrophae saturata Stgr., Exot. Tagf., 1, p. 104 (1888).
Anartia jatrophae jamaicensis Moesch., Beitr. Schmett. Jam., p. 27 (1886).
Anartia jatrophae saturata Seitz, Macrolep., v, p. 462 (1914).
Anartia jatrophae G. & S., Biol. Cent.-Am. Rhop., i, p. 222 (1914).

Range of species. Tropical America, Texas, Florida, Cuba, Hispaniola, Porto Rico, St. Lucia, Trinidad, Martinique, Guadeloupe, Dominica.

Range of subspecies. Haiti, Porto Rico, Cuba.

One of the commonest of the Jamaican butterflies and to be found all over the Island up to at least 1500 ft., but most abundant below that height, and often exceedingly common at sea-level. Always attached to dry places such as roadsides, and it frequently settles on the dry, dusty road itself and seems to disdain flowers.

Whether Jamaican specimens of *jatrophae* could always be separated from some of the other West Indian Island forms or even always from specimens from Honduras and Nicaragua seems to be doubtful, but while the *jamaicensis* form is not general anywhere on the mainland it is always the form met with in Jamaica. Very curiously another West Indian Island, Dominica, produces the very palest specimens. A very different-looking second species of *Anartia lytrea*—occurs commonly in Cuba and Hispaniola, but is not found in Jamaica.

16. Cystineura dorcas.

Papilio dorcas Fab., Syst. Ent., p. 508, n. 275 (1775).
Cystineura dorcas Kirby, Cat. Lep., p. 217 (1871); Seitz, Macrolep., v, p. 467 (1921); Moesch., Beitr. Schmett. Jam., p. 27 (1886).

Range. Confined to Jamaica.

A common butterfly in the lowlands, not extending more than a few hundred feet in altitude. Many localities produce it. Renown Bay, Feb. 1906 (*Walsingham*); "Jamaica," Oct.–Nov. 1906 (*A. Hall*); Spanish Town and Bog Walk, Aug. 1898 (*W. J. Kaye*); Hope, Oct. 1920 (*F. W. Jackson*); Moneague, Jan. 1905; Ramble (*Longstaff*). Frequently found by the roadside with *Anartia jatrophae*, but is more attached to damper situations with long grass. Dr. Longstaff records that *dorcas* often visits the flowers of Spanish Needle (*Bidens leucanthus*).

In common with other species of the genus, *Cystineura dorcas* has a feeble flight which does not suggest it belonging to the Nymphalinae. In Cuba there is no representative of *Cystineura*, while in Haiti there is the wholly isolated black-and-white species *teleboas*.

17. Megalura chiron.

Papilio chiron Fab., Syst. Ent., p. 452, n. 40 (1775).
Papilio marius Cram., Pap. Ex., iii, t. 200, f. D, E (1780); Stoll, Supp. Cram., t. 30, f. 1, 1*a* (1791).
Megalura chiron Seitz, Macrolep., v, p. 468.
Megalura chironides Stgr., Exot. Tag., i, p. 134 (Cuba).
Megalura insularis Fruhs., Stett. Zeit., 68, p. 237 (Jamaica).

Range. The whole of the tropical and subtropical parts of America, with the Greater Antilles and Trinidad.

Apparently very rare in Jamaica. Dr. W. J. Holland writes me that he has it from Bath. Fruhstorfer described his form *insularis* from a Jamaican specimen, but I have been unable to examine any specimen, and Seitz says that the forms are intergraded, and I have not therefore kept the subspecies separate.

Larva probably on *Ficus* and *Morus* (Seitz). In Porto Rico Moeschler has found it on *Maclura tinctoria*.

18. Aganisthos odius orion.

Papilio orion Fab., Syst. Ent., p. 485 (1775).
Aganisthos odius Butl. & Druce, P.Z.S., 1874, p. 341.

Papilio odius Fab., Syst. Ent., p. 457 n. 60 (1775).
Historis orion odius Seitz, Macrolep., v, p. 471.
Aganisthos orion, G. & S., Biol. Cent.-Am. Rhop., 1, p. 324.

Range of species. S. of Florida, Mexico to N. Argentina with Cuba, Hispaniola and Jamaica, Trinidad.

Range of subspecies. Haiti, Jamaica.

It is unfortunate that Seitz in his "Macrolepidoptera of the World" has reversed the names *odius* and *orion* for the two races of this species. *Orion* is the Haiti and Jamaican form, not the mainland form. Mandeville, Aug. 1923 (*A. Hall*); Stoney Hill, Oct. 1904 (*A. Hall*); Hollymount, 3700 ft., Aug. 1920, Ivor, 2000 ft., Mar. 1921 (*F. W. Jackson*); Malvern, Mocha Mountains; Fern Gully.

Not uncommon from 500–4000 ft.

Greatly attracted to sap and fruit, often remaining on a tree for days at a time.

"Larva thick and firm, with short branched spines and two short spinose clubs on the head, yellow-brownish to greenish with dark brown transverse markings on the segments." Pupa is laterally much flattened with a sharp dorsal ridge and six three-pronged dorsal spines. Head with two knotted curved protuberances. Food-plant, "Embauba" (*Cecropia*).

19. Coea acheronta.

Papilio cadmus Cram., Pap. Ex., i, t. 22, f. A, B (1775).
Papilio acheronta Fab., Syst. Ent., p. 501, n. 249 (1775).
Aganisthos cadmus Kirby, Cat. D.L., p. 264.
Coea acheronta Seitz, Macrolep., v, p. 471.
Coea cadmus G. & S., Biol. Cent.-Am. Rhop., 1, p. 326.

Range. Mexico to S. Brazil with Cuba, Jamaica, and Hispaniola.

Not at all common, and Dr. Jackson reports that it is always in company with *Aganisthos odius orion*. He gives as localities: Mocha Mountains, 1500 ft., March 1913; Hollymount, 3700 ft., September 1919. Also seen at Bath at about 700 ft. Constant Spring, Jan. 5, 1907 (*G. B. Longstaff*).

Larva suspected by Seitz to feed on *Cecropia*.

20. Gynaecia dirce.

Papilio dirce Linn., Mus. Ulr., p. 287 (1764).
Papilio dirce Linn., Syst. Nat., i, 2, p. 778, n. 171 (1767).

Papilio dirce Cram., Pap. Ex., iii, t. 212, f. C, D (1782).
Gynaecia dirce Seitz, Macrolep., v, p. 472 (1914); G. & S., Biol. Cent.-Am. Rhop., i, p. 265.

Range. Tropical Central and South America with Cuba, Hispaniola, Trinidad.

Very common at low elevations. Plentiful at Bath in August (*W. J. Kaye*). The butterfly flies wildly and settles on a bare tree trunk. Dr. Jackson reports it as common amongst the mango and other trees above the Hope Gardens.

Larva on *Cecropia peltata* (Urticaceae) and *Urvillea* sp. (Sapondaceae) in Trinidad. The food-plants in Jamaica are unrecorded. In the Biologia Centrali Americana Godman and Salvin say this species goes up to 3000 ft. in Guatemala. It is safe to say it never attains this altitude in Jamaica.

21. **Lucinia cadma.**

Papilio cadma Dru., Ill. Ex. Ent., ii, t. 18, f. 1, 2 (1773).
Lucinia cadma, Dbl. Hew., Gen. D.L., t. 30, f. 6 (1850).
Lucinia cadma Seitz, Macrolep., v, p. 475, Pl. 97*b*.

Range of species. Confined to Jamaica.

One of the rarer butterflies in the island. The representative of *cadma* in Cuba, a paler form known as *sida*, is considerably commoner on the large sister isle. *Cadma* was taken by Dr. F. W. Jackson at 2000 ft. in the Blue Mountains in the month of July (1919). He found the butterfly scarce and only succeeded in capturing two or three specimens during an active search of several months. It is highly probable that the species is not found away from the main mountain range. But actual dates and localities are badly wanted, and very little is known of this butterfly and its life-history is quite unknown. It has been taken at Hollymount at 3700 ft., but is very rare there. Mandeville, 2000 ft. (*A. Hall*).

22. **Eunica tatila tatilista.**

Cybdelis tatila H. S., Ex. Schm., f. 69–72 (1852–8).
Eunica tatila Seitz, Macrolep., v, p. 484 (1915); G. & S., Biol. Cent.-Am. Rhop., i, p. 229, Pl. xxiii, f. 14 (as *E. caerulea*).

Range of species. S. United States to Brazil, Matto Grosso, with Cuba and Hispaniola.

Range of subspecies. Jamaica.

Another of Jamaica's rare butterflies. Rae Town, 30 June, 1898 (*C. B. Taylor*). I know of no other record.

Eunica tatila tatilista n. s.sp.

The characteristic of the Jamaican race in the ♀ is the very vivid almost metallic blue of the fore-wing, the hind-wing being of a more purple blue and less intense.

23. Eunica monima monima.

Papilio monima Cram., Pap. Ex., iv, t. 387, f. F, G (1782).
Nymphalis myrto Godt., Enc. Méth., ix, p. 418, n. 213 (1823).
Eunica pusilla G. & S., Biol. Cent.-Am. Rhop., 1, p. 228.
Eunica monima Seitz, Macrolep., v, p. 485 (1915).

Range of species. Mexico to Colombia and Venezuela, Cuba, Jamaica.

Range of subspecies. Florida, Cuba, Hispaniola, Mexico, Jamaica.

Very rare in the island. Port Antonio district at about 100 ft. in June 1919 (*F. W. Jackson*).

24. Dynamine zetes.

Nymphalis zetes Mén., Bull. Acad. Moscow, p. 310 (1832).
Nymphalis zetes Mén., Nouv. Mém. Mosc., iii, p. 128, t. 11, f. 1, 2 (1834).
Dynamine zetes Röb. in Seitz, Macrolep., v, p. 506 (1915).
Dynamine egaea Gundl., Ent. Cub., p. 12.

Range. Cuba, Jamaica, Hispaniola.

Evidently quite a rare species and not ascending over 1000 ft. vertically.

Localities are given by Dr. F. W. Jackson as Long Mountain, Blue Mountain Range, 600 ft. in July 1919, Port Antonio at 100 ft. C. B. Taylor also took the species rarely. This is the only species of the genus *Dynamine* that is to be found in Jamaica or indeed any of the Antilles, Trinidad not being reckoned as one of the group.

Stony Hill, ♀ only, Oct. 1904 and 1923 (*A. Hall*).

25. Adelpha abyla.

Heterochroa abyla Hew., A.M.N.H., ii, vol. vi, p. 437, t. 9, f. 7 (1850).

Adelpha abyla Fruh. in Seitz, Macrolep., v, p. 525, Pl. 109*a* (1915); Moesch., Beitr. Schmett. Jam., p. 27 (1886).

Range. Confined to Jamaica.

Rather a rare butterfly. Dr. F. W. Jackson says, writing in August 1921, "I found *abyla* on the slopes of the Blue Mountains, but it was rare there. I caught one at an elevation of about 1000 ft., and on walking from Gordon Town to Newcastle I saw one in the distance. I have seen one on the summit of Long Mountain, and one also at Moneague about 500 ft. up from the hotel. At Hollymount the species is more numerous, and I took, as you know, several specimens in August 1920."

26. **Anaea troglodyta troglodyta.**

Papilio portia Fab., Syst. Ent., p. 507, n. 268 (1775).
Pyrrhanaea portia Holland, Butt. Book, p. 193 (1899).
Papilio troglodyta Fab., Syst. Ent., p. 502, n. 250 (1775).

Range of species. Florida, Gulf States, Cuba, Hispaniola, St. Thomas.

Range of subspecies. Jamaica.

A fine striking species. It occurs up to 2000 ft. among the foot-hills of the Blue Mountain Range. It is probably commonest at 500–800 ft. elevation. In June 1919 at 450 ft., 3 ♂, 1 ♀ (*F. W. Jackson*). Fairly common on Long Mountain at 800 ft. and a moderate quantity at Sta Cruz Mountains at 2000 ft. (*F. W. Jackson*). Constant Spring 10.vii.'99 (*C. B. Taylor*). Mandeville, Aug. 1923 (*A. Hall*). The male is of a more intense red than the female and is only faintly banded with black.

The larva is unknown, but probably feeds on a species of *Croton*. *Anaea andria*, a nearly related species of the southern states of N. America, feeds on *Croton capitatum*. There are several native species of *Croton* (Euphorbiaceae) which might form the pabulum of this species.

Troglodyta is without doubt the male sex of *portia*. There is a considerable amount of minor variation in both sexes, consisting of the suppression or intensifying of the dark markings.

27. **Anaea glycerium.**

Paphia glycerium Dbl. Hew., Gen. D.L., t. 50, f. 1 (1850).
Anaea glycerium, Röb. in Seitz, Macrolep., v, p. 583, Pl. 118*c*; G. & S., Biol. Cent.-Am. Rhop., i, p. 337 (1884).

Range. Mexico to Colombia and Venezuela, E. Brazil.

Appears to be much rarer than *A. troglodyta*, but occurs at a greater elevation. Blue Mountains, Feb. 1920, at 2000 ft. (*F. W. Jackson*).

This species may be recognised from *portia* by the absence of a dark border to the hind-wing as well as by the more brown red colour of the wings. Constant Spring, badly worn, Nov. 1923 (*A. Hall*).

28. **Hypanartia paullus.**

Papilio paullus Fab., Syst. Ent., iii. 1, p. 63, n. 199 (1793).
Vanessa paullus Godt., Enc. Méth., ix, Suppl., p. 819 (1823).
Hypanartia tecmesia Hüb., Samm. Ex. Schmett. (1816-1824).

Range. Cuba, Jamaica, Hispaniola.

Rather a rare species, but occurring up to 3700 ft. The female is paler than the male, with the markings less well defined.

Cinchona, 22.vii.'98 (*P. I. Lathy*); Moore Town, Constant Spring, 500 ft., Aug. 1923 (*A. Hall*); Ivor, 2000 ft., Hollymount, 3700 ft. (*F. W. Jackson*); Newcastle.

Larva unknown, but most probably on a species of *Celtis* (Ulmaceae), "Nettle-tree."

29. **Victorina stelenes lavinia.**

Papilio stelenes Linn., Mus. Ulr., p. 218 (1764).
Victorina stelenes lavinia Seitz, Macrolep., v, p. 463, Pl. 95*a* (1914).
Papilio lavinia Fab., Syst. Ent., p. 450.
Victorina stelenes, G. & S., Biol. Cent.-Am. Rhop., i, p. 280, n. 32 (1775).

Range of species. Texas and Florida to S. Brazil, Cuba, Hispaniola, Trinidad.

Range of subspecies. Cuba, Jamaica, Hispaniola.

The species does not break up very satisfactorily into subspecies, but the present form is as distinct as any and is characterised by being very heavily black, with a reduction of the green spaces. A very constant feature of the island race is the conspicuous orange spot at anal angle.

Very local in Jamaica, but in the greatest profusion in some of its localities, such as at Bath, where on the rotting mangoes in August literally hundreds congregate together.

On the wing from May till September and perhaps longer, but not recorded during the months of January or February.

In altitude never above 300–400 ft.

30. Euptoieta hegesia.

Papilio hegesia Cram., Pap. Ex., t. 209, f. E, F (1782).
Euptoieta hegesia Staud. & Schatz, Ex. Schmett, i, Pl. 36; ii, p. 118 (1888).
Euptoieta hegesia G. & S., Biol. Cent.-Am., i, p. 175; ii, p. 671.

Range. The Gulf States, Central America to Colombia and Lower Amazons, Cuba, Hispaniola.

A common species frequenting the lowlands. I took the insect commonly in August 1898 flying along the Bog Walk. There is a considerable variation in size. Small specimens are sometimes as little as $1\frac{1}{2}$ inches only in expanse, while large specimens are fully $2\frac{1}{2}$ inches.

Larva feeds on *Passiflora*.

Godman and Salvin in their great work the Biologia Centrali Americana give *Euptoieta claudia* as also occurring in Jamaica (p. 175) on the strength of Cramer's record, but this is highly probably an error, and I have not therefore included the species.

Family ERYCINIDAE.

Subfamily *LIBYTHEINAE.*

31. Libythea terena.

Libythea terena Godt., Enc. Méth., ix, p. 170, n. 2 (1819); Seitz, Macrolep., v, p. 623 (1916).

Range. Cuba, Hispaniola, Porto Rico.

Evidently extremely rare. I have only seen the one very old specimen in the National Collection at South Kensington. Seitz does not cite Jamaica as a locality and incorrectly gives Porto Rico (in addition to Cuba) for *L. motya*. The type of *terena* is at South Kensington and came from Porto Rico.

Family SATYRIDAE.

32. Calisto zangis.

Papilio zangis Fab., Syst. Ent., p. 486, n. 193 (1775).
Papilio agnes Cram., Pap. Ex., iv, t. 325, f. A, B (1782).

Calisto zangis Dbl. Hew., Gen. D.L., t. 66, f. 5 (1857); Lathy, Trans. Ent. Soc., 1899, p. 222; Weymer in Seitz, Macrolep., v, p. 240.

Range. Confined to Jamaica.

Quite common and locally even abundant. Found from sea-level up to 5000 ft. Lathy says up to 6000 ft., but I doubt if it ever ascends much above the 5000 ft. level. It is abundant at Castleton from 500 to 1000 ft., and occurs in a number of localities in the region of the Blue Mountains. Along the Bog Walk I met with it commonly in August 1898. Apparently on the wing all the year round. This is the only Satyrid butterfly hitherto found in Jamaica, and as there is only one (*Calisto herophile*) found in Cuba it seems doubtful if any other species exist. But it seems very anomalous that no representative of any of the mainland genera should be found, especially at the higher elevations where Satyrids become more plentiful in the tropics.

Family PIERIDAE.

33. Catopsilia eubule.

Papilio eubule Linn., Syst. Ent., i, 2, p. 764, n. 102 (1767).
Papilio sennöe Linn., Syst. Ent., i, 2, p. 764, n. 103 (1767).
Catopsilia eubule Röb. in Seitz, Macrolep., v, p. 85, Pl. 25*a*; Holland. Butterfly Book, p. 286, Pl. xxxiii, fig. 2 ♂, 3 ♂ underside, Pl. ii, fig. 2, 4 larva.

Range. From New England to Argentina, also on the Antilles, Trinidad, Cuba, Hispaniola.

A universally abundant species. It flies throughout the year and occurs at least as high as Cinchona, some 5000 ft., but whether it is on the wing over the whole twelve months at this latter elevation is doubtful. I have a specimen labelled "18.iv.06 Cinchona."

Larva pale green with darker segmentation and when young a subdorsal brown line. A yellow spiracular line is present in all stages. Food-plant *Cassia* of several species and other leguminous plants.

34. Catopsilia argante agarithe.

Papilio argante Fab., Syst. Ent., p. 470, n. 116 (1775).
Callidryas agarithe, Bois., Sp. Gén., 1, p. 623, n. 16 (1836).
Callidryas agarithe Luc. in Sagra, Hist. Cuba, vii, p. 496, t. 15, f. 4, 4*a–b* (1856).

Catopsilia argante Röb. in Seitz, Macrolep., v, p. 87 (1910), Pl. 25*a*.
Catopsilia argante agarithe Röb. in Seitz, *l.c.*, p. 87.

Range of species. N. American gulf states to Paraguay, Hispaniola, Cuba, Trinidad.

Range of subspecies. Panama, Venezuela, Haiti, Cuba, Brazil, Tobago, St. Lucia.

Fairly common and well distributed. The form *agarithe* alone occurs, and I have never seen a typical *argante* from the island. The ♀♀ vary a good deal in the heaviness of the marginal spotting. In some cases this is entirely absent on the hind-wing and is replaced by faint reddish patches.

I have a strong conviction that *agarithe* is produced by dry conditions, although it is apparently to be taken in the wet season as well as the dry in Jamaica. But the whole of the characteristics of a dry-season form are here present. Compared with *argante* all the markings are reduced and even absent, the size is small and the wings slightly more angled. All these are dry-season characters that are well known in definitely established seasonally dimorphic butterflies.

35. Catopsilia statira.

Papilio statira Cram., Pap. Ex., ii, t. 120. f. C, D (1779).
Callidryas statira Williams, Trans. Ent. Soc. Lond. (1919), pp. 76–8, Pl. vi–x.
Catopsilia statira Röb. in Seitz, Macrolep., v, p. 87, Pl. 25*b* (1910).
Aphrissa statira Butl., Lep. Ex., p. 155 (873).

Range. Panama to S. Brazil, Cuba, Hispaniola, St. Lucia, Trinidad.

Locally very common, but uncertain. The species is a strong migrant. Mr. C. B. Williams' paper on the flights of this species is of great interest, see reference above. The larva is undescribed and its food-plant not definitely known. *Cassia* or *Mimosa* are suspected by Mr. W. Potter. Sir Norman Lamont, another Trinidad observer, gives "Bois mulatre" (*Pentaclethra filamentosa*) as most probable.

In Jamaica I only once during the month of August, 1898, observed the species, but on that occasion at Yallah's River I saw clouds of the insect settling on the damp road after a heavy shower. Migrating species are notoriously uncertain in appearance and it would be useless to

quote a list of localities. It is noteworthy, however, that Dr. Longstaff during ten weeks' sojourn, Dec. 31–March 5 (1907), does not record this species amongst his captures.

36. Kricogonia castalia castalia.

Papilio castalia Fab., Ent. Syst., iii, 1, p. 188, n. 580 (1793).
Colias lyside Godt., Ent. Méth., ix, p. 98, n. 30 (1819).
Rhodocera terissa Luc., Rev. Zool., p. 429 (1852).
Kricogonia lyside Reak., Proc. Ent. Soc. Phil., ii, p. 355 (1863); G. & S., Biol. Cent.-Am. Rhop., ii, p. 150.
Kricogonia unicolor G. & S., *l.c.*, p. 151.

Range of species. Texas to Venezuela, Cuba, Hispaniola, Trinidad.

Range of subspecies. Jamaica.

Not at all common. The butterfly was reared by Mr. C. B. Taylor about 1897, but no record was published and the life-history is still unknown. Apparently this is never a common butterfly anywhere.

37. Gonepteryx maerula.

Papilio maerula Fab., Syst. Ent., p. 479, n. 157 (1775).
Gonepteryx maerula Röb. in Seitz, Macrolep., v, p. 89.
Amynthia maerula Butl. & Druce, P.Z.S., 1874, p. 360.
Anteos maerula G. & S., Biol. Cent.-Am. Rhop., ii, p. 149.

Range. Mexico to S. Peru, Cuba, Hispaniola.

Local. Common at sea-level near Yallah's River, Aug. 1898 (*W. J. Kaye*).

38. Terias elathea.

Papilio elathea Cram., Pap. Ex., ii, t. 99, f. C, D (1779).
Terias lucina Poey, Mem. Cuba, t. 18, ff. 8–10 (1851).
Terias palmyra Poey, Mem. Cuba, t. 24, pp. 4–6 (1851).
Terias elathides Stgr., Ex. Schmett., p. 28 (1888).
Terias elathea Röb. in Seitz, vol. v, p. 84.
Papilio delia Cram., Pap. Ex., iii, t. 273, f. A (1782).
Terias delia Röb. in Seitz, v, p. 83.
Terias lydia G. & S., Biol. Cent.-Am. Rhop., ii, p. 170.

Range. Gulf States of N. America to South Brazil, Cuba, Hispaniola, Trinidad.

"Very variable and seasonally dimorphic as well as being sexually dimorphic. The black stripe along inner margin of male fore-wing is very variable and can be either straight,

curved, heavy or slender, absent or united with outer margin. The dry-season male form has a black patch at apex of hind-wing (= *palmyra*). The wet-season form (typical *elathea*) has a black margin to hind-wing. In the female of both forms there is no inner marginal streak, otherwise the phase of variation is the same" (Kaye).

A common species with a wide distribution in the island. Probably on the wing all the year round.

It is practically certain that *delia* and *elathea* are the same species, and they are therefore here united.

39. Terias adamsi.

Sphaenogona adamsi Lathy, Ent. Mo. Mag., p. 200 (1898); Longstaff, Trans. Ent. Soc. Lond., p. 48 (1908).

Range. Known only from Jamaica.

This neat and distinct little species occurs only at high altitudes. It was originally described by Lathy from Cinchona at 5000 ft. altitude and taken 28.vi.98. Lathy says: "This does not appear to be a common insect. I first met with it this year (1898) early in March, at Cold Spring in the Port Royal Mountains: I afterwards found it at Content and Guava Ridge in the Port Royal Mountains and at Cinchona, Resource and Berwick in the Blue Mountains. I never saw it in the plains; all that I captured being taken at elevations of from 2500 to 5500 ft. . . . During the whole of March and April when I was collecting on the Port Royal and Blue Mountains I only managed to get about a dozen specimens; they are difficult to capture owing to the mountainous nature of the country and their swift flight, not unlike that of a *Colias*."

The species was taken by the late Dr. G. B. Longstaff near Constant Spring and in the Manchester Mountains at Contrivance, 2700 ft., and Mile Gully Mountains at the same elevation. Dr. F. W. Jackson more recently took it at Hardwa Gap in the Blue Mountains at 4000 ft. in Feb. 1920. It was fairly common locally. Another locality is Mount Airy, at 3000 ft., 17.xi.98. Mr. A. Hall met with the species at Spur Hill, Mandeville, in Aug. 1923. It is clear the species covers a considerable area at a suitable elevation.

The species is sexually dimorphic. The males are white with a continuous black marginal band to both fore- and hind-wing. This varies very greatly and may be influenced

by the season. Some have a band of nearly a quarter of an inch at the tornus of fore-wing and others have only as little as $\frac{1}{16}$ inch. The females are much more constant. The ground-colour is white with a slight greenish tinge and a black apical band to fore-wing only.

Seitz in his great work the "Macrolepidoptera of the World" omits all reference to this species, and Röber, who did the American Pierinae, evidently did not know of the existence of this species.

40. Terias messalina.

Papilio messalina Linn., Mant. Ins., ii, p. 22, n. 236 (1787).
Terias messalina Bois., Sp. Gen., i, p. 679, n. 43 (1836); Longstaff, Trans. Ent. Soc., 1908, p. 48.

Range. Cuba, Jamaica.

Widely distributed and not rare. Castleton, Aug. 1898 (*W. J. Kaye*); Irish Town, Nov. 1897 (*P. I. Lathy*); Blue Mountain foot-hills, 800 ft., Dec. 1919, Jan.–Mar. 1920 (*F. W. Jackson*); Constant Spring hotel grounds and wood to N.E. Mackfield (common), Montego Bay, Spanish Town, Port Antonio (*G. B. Longstaff*).

Sexes considerably different. The males are more opaquely white and have a narrow black margin to hind-wing. They are also markedly smaller than the females. The female is more transparent white; never has the black marginal band of fore-wing reaching to tornus. The hind-wing has only a black marginal patch at extremity of vein 7, and the underneath pattern shows through more noticeably.

41. Terias dina parvumbra.

Terias westwoodii Bv., Sp. Gen., 1, p. 666, n. 22 (1836).
Terias westwoodi Röb. in Seitz, Macrolep., v, p. 82.
Terias dina Poey, Cent. Lep., ii, Decade; G. & S., Biol. Cent.-Am. Rhop., ii, p. 163.

Range of species. Texas and Arizona to Costa Rica, Cuba.
Range of subspecies. Jamaica.

parvumbra s.sp. nov.

Like *westwoodi* but smaller, paler, and with a very narrow fore-wing marginal band.

An active species on the wing, often flying out of reach. Never very common and probably not ascending any great altitude. I met with the species at Castleton (500 ft.),

but only flying singly in Aug. 1898. Mandeville, 2000 ft. July 1923 (*A. Hall*); Constant Spring, apparently pretty widely spread; Montego Bay (*G. B. Longstaff*). The ♀, with the much broader black apical margin and orange patch below at upper margin of hind-wing, is considerably scarcer than the ♂.

42. Terias euterpe.

Xanthidia lisa Bois., Lep. Am. Sept., p. 53, t. 19, f. 4, 5 (1833).
Terias lisa Bois., Sp. Gen., 1, p. 661, n. 16 (1836).
Colias euterpe Mén., Bull. Mosc., p. 299, n. 13 (1832).
Eurema lisa Moesch., Beitr. Schmett. Jam., p. 26 (1886).
Terias euterpe G. & S., Biol. Cent.-Am. Rhop., ii, p. 162; Röb. in Seitz, Macrolep., v, p. 83.

Range. New England to Nicaragua, Bermuda, Cuba, Hispaniola.

Larva green with two whitish stripes on each side. Head yellowish. Food-plants *Cassia* and clover.

Very common from sea-level up to 2000 ft. Easily the commonest *Terias*, and on the wing in probably every month of the year. The ♀ varies from yellow to complete white, and the black apical band of fore-wing varies greatly in width.

The reputed occurrence of *Terias venusta*, a Colombian species with a dotted margin to hind-wing, is due probably to confusion with *T. euterpe*.

43. Nathalis iole.

Nathalis iole Bois., Sp. Gen., i, p. 589 (1836).
Nathalis felicia Poey, Mem. Cuba, i, p. 443, n. 14, t. 1, f. 8 (1853).
ab. *Nathalis irene* Fitch, Tr. N. York State Agric. Soc., p. 485 (1856).
Nathalis iole, G. & S., Biol. Cent.-Am. Rhop., ii, p. 172; Pl. lxiv, ff. 15–18; Röb. in Seitz, Macrolep., v, p. 95, Pl. 27*h*.

Range. Texas, Cuba, Hispaniola, Mexico to Colombia.

Only found at considerable elevations. Cinchona, 4900 ft., May, June, July, Aug. (*P. I. Lathy*); Cold Spring, 3500 ft., Aug. 1895 (*C. B. Taylor*). Like many of the higher-altitude butterflies extremely local. Mandeville, 2000 ft., very common, Aug. 1923 (*A. Hall*).

44. Pieris amaryllis amaryllis.

Papilio amaryllis Fab., Syst. Ent., iii, 1, p. 189, n. 586 (1797).
Pieris josephina Godt., Enc. Méth., ix, p. 158, n. 136 (1819).
Pieris amaryllis Röb. in Seitz, Macrolep., v, p. 58.
Pieris josepha G. & S., A.M.N.H. (4), 2, p. 150; Biol. Cent.-Am. Rhop., ii, p. 135.

Range of species. Mexico to Nicaragua, Hispaniola, Jamaica, Porto Rico.

Range of subspecies. Jamaica.

Rather scarce. Blue Mountain foot-hills, Dec. 1919, Feb. and March 1920, 560–800 ft. (*F. W. Jackson*); Hill Gardens (*C. B. Taylor*), 1898.

A very distinct island race of a widely spread and variable insect. The type form was named from Jamaica.

This is a very interesting species because of its curious distribution. It is not found in Cuba, while it is existent in Haiti and Porto Rico as well as on the mainland of Central America as far south as Nicaragua.

45. Pieris monuste virginia.

Papilio monuste Linn., Mus. Ulr., p. 237 (1758).
Pieris virginia Godt., Enc. Méth., ix, p. 141.
Pieris monuste virginia Röb. in Seitz, Macrolep., v, p. 57 (1909).
Pieris monuste G. & S., Biol. Cent.-Am. Rhop., ii, p. 132.

Range of species. From the Gulf States of N. America to Argentina, Cuba, Trinidad, Hispaniola.

Range of subspecies. ? Jamaica only.

A very common butterfly occurring from sea-level up to 4900 ft. (Cinchona). At sea-level appearing continuously, but at the higher elevation perhaps more confined to seasons. At Cinchona it certainly flies in July and August.

46. Glutophrissa drusilla jacksoni.

♀. *Papilio drusilla* Cram., Pap. Ex., ii, t. 207, f. C (1779).
♂. *Pieris ilaire* Godt., Enc. Méth., ix, 10, p. 142, n. 83 (1819).
Appias drusilla Röb. in Seitz, vol. v, p. 68 (1909).
Glutophrissa drusilla jacksoni Kaye, Ent. Rec., xxxii, p. 188 (1920).

Pieris margareta G. & S., Biol. Cent.-Am. Rhop., ii, p. 135 (1889).
Mylothris margarita Hüb., Samm. Ex. Sch., ii, t. 120.

Range of species. Central America to S. Brazil, Rio, West Indies, Trinidad, Cuba, Hispaniola, Jamaica.

Range of subspecies. Jamaica.

Fairly common up to 1000 ft. in the Blue Mountain area. Foot-hills of Blue Mountain, 800 ft., Feb. 1920 (*F. W. Jackson*); Hill Gardens (*C. B. Taylor*); Yallah's River, Aug. 1898 (*W. J. Kaye*). Probably on the wing during the greater part of the year.

The species is geographically, individually, as well as to some extent seasonably, variable. The ♂ of *jacksoni* is almost pure white above and the ♀ creamy white with a narrow black margin to apex. Both sexes have a curious patch of glistening scales at base of fore-wing above.

Family PAPILIONIDAE.

Subfamily *PAPILIONINAE.*

Section I.

47. **Papilio polydamas jamaicensis.**

Papilio polydamas Linn., Syst. Ent., x, p. 460, n. 11 (1758).
Papilio polydamas var. *polycrates* Cockerell, Jam. Inst., i, p. 27 (1891), larva; Fox & Johns Ent. News, iv, p. 3 (1893).
Papilio polycrates Robinson, Ent. News, xiv, p. 18 (1903).
Papilio polydamas jamaicensis Roths. & Jord., Nov. Zool., xiii, p. 522, Pl. vii, f. 40 (1906); Jord. in Seitz, Macrolep., v, p. 21 (1907).

Range of species. Southern Atlantic States to Buenos Ayres, West Indies, Trinidad, Cuba, Hispaniola.

Range of subspecies. Jamaica.

A very common species, and to be taken in May, June, July, August, September and October and perhaps other months as well. Apparently spread all over the island and ascending as high as 4000 ft.

♂ ♀. "Close to *P. polyd. polycrates* from Haiti, differing in the rufous brick-red spots of the underside of the hind-wing being larger and the white spots attached to them smaller, the fourth red spot being usually without a vestige

of white at its hinder end, and the fifth and sixth spots mostly without any white scales at both ends" (R. & J.).

Larva on *Aristolochia* sp.

Section II.

48. Papilio thoas melonius.

Papilio cresphontes Cram., Pap. Ex., ii, p. 106 (1777) (*partim*).

Papilio thoas G. & S., Biol. Cent.-Am. Rhop., ii, p. 223 (part).

Papilio cresphontes Dbl., West. & Hew., Gen. D. L., i, p. 17, n. 169 (1846) (*partim*).

Papilio thoas melonius Roths. & Jord., Nov. Zool., xiii, p. 556; Jord. in Seitz, v, p. 24 (1907).

Range of species. Texas to Buenos Ayres, Cuba, Jamaica, Porto Rico, St. Thomas, Trinidad, St. Lucia, Dominica, Martinique, Guadeloupe.

Range of subspecies. Jamaica.

The difference in pattern and in the genitalia are so slight between this subspecies of *thoas* and *crespontes* that one cannot help wondering if these two species are anywhere in their range one only. In Cuba *P. thoas oviedo* seems distinct from *cresphontes*, although Gundlach (who resided in Cuba for years) considered them to be the same species. If *thoas melonius* had not existed the acceptance of the two species would have been easier, but it bridges the two and has the fascies of *cresphontes*, while it is claimed by Rothschild and Jordan to really belong to *thoas*.

Locally common in the foot-hills of the Blue Mountain Range. Dr. F. W. Jackson found the species in fine condition in December 1919 at 700 ft. and again in February 1920 at 800 ft. Also in July. Apparently two broods, a spring and a summer generation.

Attracted to the blossoms of *Poinsettia* and *Bauhinia* as well as *Bougainvillea*.

49. Papilio thersites.

♂ *Papilio thersites* Fab., Syst. Ent., p. 453, n. 43 (1775).

♀ *Papilio palamedes* Fab. (*non* Drury 1770), Syst. Ent., p. 454, n. 45 (1775).

Papilio thersites Gray, List. Lep. Ins. Brit. Mus., i, Pap., p. 52, n. 200 (1856).

Papilio thersites Haase, Untersuch. Mimicry, i, p. 97 (1893); Towns, Jour. Inst. Jam., 1, p. 376 (1893), larva; Roths. & Jord., Nov. Zool. (1906), p. 572; Jord. in Seitz, Macrolep., v, p. 25 (1907).

Range of species. Jamaica.

A large handsome species with a strikingly different female. The male strongly resembles *P. lycophron*, although that species does not inhabit any of the West Indian Islands. The butterfly is never common and is found among the foot-hills of the Blue Mountain Range up to 800 ft. Dr. F. W. Jackson took both sexes in July 1919 and from December 1919 to March 1920 at that elevation. Mr. C. B. Taylor took males in July near Constant Spring. There are apparently two broods, one in February and another in July.

The larva is said to closely resemble that of *Papilio androgeus*, a species that may yet be found in the island, as it is a native of Cuba, Haiti and Porto Rico. Dr. Jackson found ♀♀ much rarer than ♂♂, although the males were never common. This species flies with *P. thoas melonius*, and like that species frequents the blossom of *Poinsettia* and *Bauhinia*.

50. Papilio pelaus pelaus.

Papilio pelaus Fab., Syst. Ent., p. 444, n. 9 (1775); Westw., Arc. Ent., i, p. 107, t. 18, f. 1, 2 (1842); Gray, List Lep. Ins. Brit. Mus., i, Pap., p. 55, n. 213 (1856); Fox & Johns, Ent. News, iv, p. 3 (1893); Cockll., Psy., vi, p. 45 (1893), larva; Cockll., Journ. Ins. Jam., i, p. 179 (1893), larva; Swains., Journ. Ins. N. York Ent. Soc., ix, p. 78 (1901), larva; Roths. & Jord., Nov. Zool. (1906), p. 602; Jord. in Seitz, Macrolep., v, p. 28 (1907); Haase, Untersuch. Mimicry, i, p. 98 (1893).

Range of species. Jamaica, Cuba, Hispaniola, Porto Rico.
Range of subspecies. Jamaica, Cuba.

Never a common species. It occurs all over the Blue Mountain Range up to 5000 ft., but is commoner at from 3000–4000 ft. than lower down. Hollymount 3700 ft. June–September 1919 (*F. W. Jackson*). Recorded from Bath, Moore Town and Fish River. Bath, 15–17 Mar. 1902, with *Pap. homerus* (*F. W. Jackson*).

51. Papilio homerus.

Papilio homerus Fab., Syst. Ent., i, p. 29, n. 85 (1793).
Papilio homerus Dbl. & Hew., Gen. D. L., i, p. 13, n. 83, t. 4, f. 1, ♀ (1846).
Papilio homerus Swains., Jour. N. York Ent. Soc., ix, p. 77 (1901).
Papilio homerus Taylor, Ent. News, v, p. 101 (1894), life-history.

Range of species. Jamaica and Haiti (?).

This grand butterfly, discovered so long ago as 1793, until recently had remained a very rare insect. Its habitat is on the northern side of the Blue Mountains at low elevations, never apparently ascending higher than 500 ft. The larva feeds on *Hernandia catalpaefolia*, often called "Mahoe," but according to Mr. W. Harris erroneously, and is to be found in November and December. The butterfly is out in April and May and apparently again as a second brood. It is a striking species on the wing and has a rather lazy flight, but is sufficiently difficult to catch. It is locally not rare, and sometimes is to be seen in numbers on the northern slopes of the mountains in St. Thomas. The butterfly has been reported from the Cockpit country as well as from Mt. Diablo near Ewarton, but its real home is the eastern Blue Mountain, and although found on both slopes it is far more plentiful on the northern side. On the southern side at Bath, 15–17 Mar. 1902 (*F. W. Jackson*).

Section III.

52. Papilio marcellinus.

Papilio sinon Fab., Syst. Ent., p. 452, n. 39 (1775).
Papilio marcellinus Dbl., List. Lep. Ins. Brit. Mus., 1, p. 8 (1845).
Papilio marcellinus West. & Hew., Gen. D. L., 1, p. 15, n. 131 (1846).
Papilio marcellinus Obth., Et. d'Ent., iv, p. 65, n. 72 (1880).
Papilio sinon Moesch., Beitr. Schmett. Jam., p. 26 (1886).

Range. Confined to Jamaica.

According to the rules of nomenclature if a name has once been used in a genus, even if incorrectly and as a synonym, it must not be used again. For this reason the

name *sinon*, although applied to the present Jamaican *Papilio* for 150 years, has to make way for *marcellinus*, because Poda by an oversight wrongly named the European *Papilio podalirius* as *sinon*. The present writer disagrees with this rule as applying to synonyms which are really errors, but for uniformity with the rule adopts the name *marcellinus* as above.

Not at all common. Constant Spring and along the foot-hills eastwards of the Blue Mountain Range. St. Thomas, in May 1892 (*C. B. Taylor*).

Family LYCAENIDÆ.

53. Thecla simaethis

Papilio simaethis Dru., Ill. Ex. Ent., i, t. 1, f. 3 (1773).
Thecla simaethis Draudt in Seitz, Macrolep., v, p. 798, Pl. 158, f. (1920); G. & S., Biol. Cent.-Am. Rhop., ii, p. 81 (1887).

Range. Texas to S. Brazil, Cuba, Jamaica, Hispaniola, Trinidad.

A very much commoner insect than *T. crethona*, with which it might easily be confounded, *simaethis* can be at once separated by the fine silvery transverse streak on the underside to both wings. Blue Mountain foot-hills, Feb. 1919, at 500 ft., Nov. 1919, at 500 ft., Jan. 1920, 3700 ft. (*F. W. Jackson*). Godman and Salvin say of this species "nowhere common," but in Jamaica, while it is not actually abundant, it is certainly common.

54. Thecla crethona.

Thecla crethona Hew., Ill. D. L., p. 157, n. 276, t. 62, ff. 420, 421 (1873).
Thecla crethona Draudt in Seitz, Macrolep., v, p. 799, Pl. 158, f. (1920).

Range. Jamaica and Cuba.

Rather scarce. The underside figure in Seitz is bad and misleading. Except for the absence of a "hairstreak" below there is considerable similarity to *simaethis*. Blue Mountain foothills, 500 ft., Dec. 1919 (*F. W. Jackson*).

55. Thecla telea.

Thecla telea Hew., Desc. Lyc., p. 4, n. 10 (1868).

Thecla telea Draudt in Seitz, Macrolep., v, p. 798 (1920); G. & S., Biol. Cent.-Am. Rhop., ii, p. 82 (1887).

Range. Mexico to S. Brazil, Paraguay, Cuba, Jamaica, Trinidad.

Although very widely spread never common. Blue Mountain foot-hills, 500 ft., Nov. 1919 (*F. W. Jackson*). From *simaethis* and *crethona* the species is to be recognised by its smaller size and brilliant violet blue colour above.

56. Thecla pan.

Papilio pan Drury, Ill. Ex. Ent., ii, t. 23, f. 3, 4 (1773); Seitz, Macrolep., v, p. 824.

Range. Confined to Jamaica.

Fairly well distributed, but never common.

57. Callicista bubastus.

Papilio bubastus Cram., Pap. Ex., iv, t. 332, f. G, H (1782).
Thecla salona Hew., Desc. Lyc., p. 31, n. 67 (1868).
Thecla bubastus Draudt in Seitz, Macrolep., v, p. 809, Pl. 145*h*.
Thecla columella Draudt (*nec* Fab.) in Seitz, v, p. 809.

Range. Venezuela to Paraguay, Grenada, St. Vincent, St. Lucia, Dominica, St. Thomas, Hispaniola.

The nearly related *eurytulus* occurs commonly in Central America. It is perhaps only a tailed form of *bubastus*, and as that occurs in Jamaica it would be strange if that common " species " was absent from C. America.

58. Callicista columella.

Papilio columella Fab., Syst. Ent., iii, 1, p. 282, n. 83 (1793).
Thecla limenia Hew., Desc. Lyc., p. 32; Hew., Ill. D. L., p. 160, n. 284, t. 63, ff. 431, 432 (1874).
Callicista ocellifera Grote, Bull. Buff. Soc., 1, p. 178 (1873).

Range. Cuba, Jamaica, Hispaniola.

A very rare species in all the islands it inhabits. The species much resembles *Calycopis angerona* from St. Vincent and Grenada in having below a very large red patch near anal angle of hind-wing.

No localities are available, and I have been unable to see any recent captures of this insect.

59. Callipsyche thius.

Hyreus thius Hüb., Znt. Ex. Sch., f. 743, 744 (1832).
Thecla thius Draudt in Seitz, v, p. 810 (1920).

Range. Mexico to Argentina and Sandwich Isles, Trinidad.

Not rare, but never abundant. Blue Mountain foothills, 500 ft. (*F. W. Jackson*).

60. Eupsyche acis.

Papilio acis Dru., Ill. Ex. Ent., i, t. 1, f. 2 (1773); Cram., Pap. Ex., ii, t. 175, f. C, D (1779).
Thecla acis Draudt in Seitz, Macrolep., v, p. 798, Pl. 158*e*.

Range. S. Florida, Cuba, Dominica.

Not common. Blue Mountains, 600 ft., July 1919; 500 ft., Nov. 1919 (*F. W. Jackson*).

61. Leptotes cassius.

Papilio cassius Cram., Pap. Ex., i, t. 23, f. C, D (1775).
Syntarucoides cassius Kaye, Trans. Ent. Soc. Lond., p. 190 (1904).
Leptotes cassius Draudt in Seitz, Macrolep., v, p. 820 (1921).
Lycaena marina Reak., Proc. Ac. Phil. (1868), p. 87; G. & S., Biol. Cent.-Am. Rhop., ii, p. 106.

Range. Mexico to S. Brazil, Cuba, Hispaniola, Dominica, St. Lucia, Trinidad.

A very common species and to be found from sea-level up to 5000 ft. The females of *L. cassius* from Jamaica are rather strongly powdered with metallic blue scaling, but less than in an example from St. Lucia which has the strongest suffusion of any.

62. Chilades hanno.

Papilio hanno Stoll, Suppl. Cram. Pap. Ex., t. 39, f. 2 (1790).
Hemiargus hanno Draudt in Seitz, Macrolep., v, p. 819, Pl. 144*k*.
Chilades zachaeina Butl., Cist. Ent., 1, p. 104.
Lycaena dominica Moesch., Beitr. Schmett. Jam., p. 26 (1886).
Hemiargus zachaeina Draudt in Seitz, Macrolep., v, p. 819, Pl. 144*k*.
? *Hemiargus ammon dominica* Draudt in Seitz, *l.c.*, p. 820.

Lycaena filenus Poey, Cent. Lep. (1833?); Moesch., *l.c.*, p. 26.

Range. Florida to S. Brazil, West Indies, Trinidad, Cuba, Hispaniola.

A very common roadside butterfly.

Larva suspected of feeding on *Oxalis barrelieri* of the Geraniaceae.

Family HESPERIDAE.

Subfamily *HESPERIINAE.*

63. **Eudamus proteus.**

Papilio proteus Linn., Mus. Ulr., p. 333 (1764).

Eudamus proteus Draudt in Seitz, Macrolep., v, p. 853, Pl. 160*b*; G. & S., Biol. Cent.-Am. Rhop., ii, p. 277 (1893).

Range. Southern states of U.S.A. to Argentina, West Indies, Trinidad, Cuba, Hispaniola.

Larva green, posteriorly reddish, with a red-brown head and light lateral stripes. On Papilionaceous plants. Almost a pest and known as the bean-leaf roller in Trinidad.

On the wing practically the whole year round.

64. **Eudamus catillus.**

Papilio catillus Cram., Pap. Ex., iii, t. 260, f. F, G (1782).

Eudamus catillus Draudt in Seitz, Macrolep., v, p. 854, Pl. 160*a*; G. & S., Biol. Cent.-Am. Rhop., ii, p. 280 (1893).

Range. Venezuela, Colombia, Brazil, Peru, Paraguay, Argentine, Trinidad.

I have a specimen in my collection labelled Jamaica. One in B.M. (*F. W. Jackson*).

65. **Telegonus anaphus hahneli.**

Papilio anaphus Cram., Pap. Ex., ii, t. 178, f. F (1779).

Aethilla hahneli Stgr., Ex. Tag., p. 291; Draudt in Seitz, Macrolep., v, p. 863, Pl. 167*b*, *c*.

Telegonus hahneli G. & S., Biol. Cent.-Am. Rhop., ii, p. 306, Pl. 77, ff. 13, 14.

Range of species. Mexico to S. Brazil, Cuba, Hispaniola, Grenada, Trinidad.

Range of subspecies. Colombia.

I have but the single record of my own capture made in August 1898. No locality is on the specimen except Jamaica, but it most likely came from Bath.

66. Telegonus creteus jaira.

Papilio creteus Cram., Pap. Ex., iii, t. 284, f. C, D (1782).
Telegonus jaira Butl., Trans. Ent. Soc., Lond. (1870) p. 496.
Telegonus creteus Butl. & Druce, P.Z.S. (1874), p. 367.
Telegonus cretellus Plötz (*nec* H. S.).
Telegonus hurga Longstaff (? Schs.), "Butterfly hunting in Many Lands," p. 288.

Range of species. Mexico to S.E. Brazil.
Range of subspecies. Jamaica.
Bath, August 1898 (*W. J. Kaye*). Hollymount, 3700 ft. (*F. W. Jackson*).

67. Proteides idas.

Papilio idas Cram., Pap. Ex., iii, Pl. 260, f. A, B (1782).
Proteides idas Draudt in Seitz, *l.c.*, p. 861.
Eudamus idas Plötz, Stett. Ent. Zeit. (1882), p. 92.
Proteides idas G. & S., Biol. Cent.-Am. Rhop., ii, p. 301, Pl. lxxvii, f. 5 ♂.

Range. Southern U.S.A., Arizona to S. Brazil, Cuba, Porto Rico.

Larva "honey-coloured, strewn with dark brown, with brown transverse bands and a red lateral stripe and head" on tree like Papilionaceae also *Cassia.*

Pupa "bluish, in a leaf drawn together like a trough by means of two threads."

Rather an uncommon butterfly in Jamaica, although not usually so on the mainland. Dry River, Kingston, 450 ft., June 1919 (*F. W. Jackson*).

68. Epargyreus antaeus.

Eudamus antaeus Hew., Descr. Hesp., p. 8, n. 12 (1867).
Epargyreus antaeus Draudt in Seitz, Macrolep., v, p. 861, Pl. 166 f.
Epargyreus asander Draudt, *l.c.*, p. 861; G. & S., Biol. Cent.-Am. Rhop., ii, p. 300, Pl. lxxvii, f. 4.
Eudamus asander Hew., Desc. Hesp., p. 9, Ex. Butts. Eudamus, t. 3, f. 24.

Range. Mexico to Amazon Valley, Hispaniola.

There is considerable variation in these two so-called species (*antaeus* and *asander*), and it seems most likely that they are one and the same.

69. Acolastus amyntas.

Papilio amyntas Fab., Syst. Ent., p. 533, n. 384 (1775).
Acolastus amyntas Draudt in Seitz, Macrolep., v, p. 862, Pl. 166*g*; Wats., P.Z.S. (1893), p. 25; G. & S., Biol. Cent.-Am. Rhop., ii, p. 304.

Range. Mexico to S. Brazil, Trinidad, Cuba, Hispaniola.

Not rare. From sea-level up to 4000 ft. at Newcastle. The latter record I should have felt inclined to question as I have only met with the species near the coast.

70. Cabares potrillo.

Thanaos potrillo Lucas. Sag. Hist. Cuba, vii, p. 641.
Cabares potrillo Draudt in Seitz, Macrolep., v, p. 878; G. & S., Biol. Cent.-Am. Rhop., ii, p. 337 (1894).

Range. Mexico, Central America, Cuba, Hispaniola, Trinidad, Colombia, Venezuela.

Evidently rare in Jamaica. 1 ♂, "Jamaica," 1898 (*W. J. Kaye*).

71. Pellicia bromias.

Pellicia bromias G. & S., Biol. Cent.-Am. Rhop., 2, p. 415, Pl. lxxxiii, ff. 13–15; Draudt in Seitz, Macrolep., v, p. 891 (1922).

Range. Mexico to Panama, Trinidad.

Only one record, but probably the species is overlooked. It is common on the mainland, and is most likely not really rare in Jamaica. "Jamaica," Aug. 1898 (*W. J. Kaye*).

72. Echelatus simplicior.

Anastrus simplicior Plötz, Ex. Schmett., 20., Hesp., Tab. 1015.
Echelatus simplicior Draudt in Seitz, Macrolep., v, p. 890, Pl. 1756.

Range. Trinidad, Brazil, Paraguay, Hispaniola.

A single record only in June 1919, at 500 ft., in Blue Mountain foot-hills (*F. W. Jackson*).

73. Grais stigmaticus.

Grais stigmaticus Mab., Bull. Soc. Ent. Fr., p. 54 (1883); Draudt in Seitz, Macrolep., v, p. 897, Pl. 175*b*; G. & S., Biol. Cent.-Am. Rhop., ii, p. 381, Pl. lxxxiv, ff. 24–26.

Range. Mexico to S. Brazil, Trinidad.

In Jamaica rather a rare butterfly. One in coll. B.M. (*Saunders*). Recorded from Jamaica by Godman and Salvin.

74. Eantis thraso.

Urbanus vetus thraso Hüb., Samm. Ex. Sch. (1806–1816).
Hesperia papinianus Poey, Cent. Lep. (1833) Luc., Sag. Hist. Cuba, vii, p. 651 (1857).
Eantis thraso Draudt in Seitz, Macrolep., v, p. 902, f. 176*b*.
Eantis papinianus Draudt, *l.c.*, f. 176*c*.
Eantis thraso, G. & S., Biol. Cent.-Am. Rhop., ii, p. 405, Pl. lxxxvii, f. 7.
Achlyodes philemon Panton, Journ. Ins. Jamaica, ii, 5. p. 435 (1897), Pl. ff. 1–3.

Range. Mexico to S. Brazil, Cuba, Hispaniola, Trinidad.

Papinianus is the ♀ of *thraso*. The species is fairly common in Jamaica. Panton has given an interesting account of this not very common Jamaican butterfly.

75. Timochares ruptifasciata.

Timochares ruptifasciata Plötz, Jahr. Nassau Ver. Nat. p. 27 (1884); Draudt in Seitz, Macrolep., v, p. 907, Pl. 177*a*. G. & S., Biol. Cent.-Am. Rhop., ii, p. 418, Pl. lxxxviii, ff. 1, 2 (1896).

Range. Mexico.

Long Mountain, 600–700 ft., Mona, 700 ft. in April 1920 (*F. W. Jackson*).

Although the only other species (*trifasciatus*) in the genus *Timochares* has a very wide range of distribution, occurring from Mexico to Argentina, the range of *ruptifasciata* is remarkably restricted. It is noteworthy that the Jamaican species should be *ruptifasciata* hitherto only recorded from Mexico.

76. Chiomara gesta.

Thanaos gesta H. S., Corr. Bl. Zool. Min. Ver Regens, 17, p. 142 (1863).

Chiomara gesta Draudt in Seitz, Macrolep., v, p. 913, Pl. 178*a*; G. & S., Biol. Cent.-Am. Rhop., ii, p. 455, Pl. xci, ff. 7–9.

Range. Mexico to S. Brazil, Cuba, Jamaica, Hispaniola, Trinidad.

A series taken in August 1898 without precise locality (*W. J. Kaye*). On the Continent in Central America Godman and Salvin record the species from sea-level up to about 3000 or 4000 ft. They also quote Jamaica as a locality for this species.

77. Rhinthon thermae.

Rhinthon thermae n.sp.

Head and thorax brown with some greenish scaling. Palp beneath whitish. Antennae brown with the club black and just before the club beneath cream-coloured. Abdomen brown. Fore-wing dark brown with a conspicuous semitransparent discal band composed of two irregular patches, the upper one shaped rather like a capital letter E and lying within the end of the cell and the lower one rather larger just outside the cell between veins 2, 3. A smaller whitish spot between veins 3, 4, and three small subapical dots in a row. Hind-wing paler brown than the fore-wing except a broad costal area which is of the same colour as fore-wing. Fore-wing below paler than above except in basal area. A pale area below vein 2. Hind-wing below light brown of the same colour as fore-wing in the apical area, but irrorated with small greenish-yellow scales. A small white dot at end of cell and a faint indication of one or two dots midway to outer margin. Underside of abdomen with the segments well defined with light scales.

Exp. 44 mm.

Habitat. Jamaica, Bath, Aug. 1898 (*W. J. Kaye*).

78. Heliopetes arsalte.

Papilio arsalte Linn., Mus. Ulr., p. 245 (1764).

Heliopetes arsalte Draudt in Seitz, Macrolep., v, p. 914, Pl. 178*c*, *d*; G. & S., Biol. Cent.-Am. Rhop., ii, p. 445, Pl. xc, ff. 17–19 (1897).

Range. Mexico to Paraguay, Trinidad, Hispaniola.

Godman in the Biologia Centrali Americana records this species from Jamaica; Draudt, perhaps following Godman's record, also gives Jamaica in Seitz' Macrolepidoptera, v, p. 914. I have, however, seen no

Jamaica specimen of this very common species, and feel there is considerable doubt as to whether it is really an inhabitant of the island.

79. Hesperia syrichtus.

Papilio syrichtus Fab., Syst. Ent., p. 534, n. 394 (1775).
Hesperia syrichtus Draudt in Seitz, Macrolep., v, p. 918; G. & S., Biol. Cent.-Am. Rhop., ii, p. 445, Pl. xc, f. 27.
Pyrgus montivaga Panton, Jour. Ins. Jamaica, ii, 5, p. 437 (1897), life-history.

Range. Everywhere from Mexico to Paraguay, West Indies, Trinidad, Cuba, Hispaniola.

Very abundant from sea-level to 5000 ft.

Larva feeds on a yellow-flowered species of *Sida* (*W. Buthn*). Pupa in frail cocoon. On the continent Godman records the species up to 7000 or 8000 ft.

Panton gives an account of the life-history of this common species in Jamaica, and says that *Sida rhombifolia*, one of the species of broom weeds, is the food-plant of the larva of this species. The duration of the larval stage is 27 days and that of the pupal 14 days. "The larva feeds when very young on the unexpanded calyces of the conical flower-buds or in the deep narrow passage of a very young and undeveloped leaf, across which it stretches silk threads." As the larva grows larger it hides beneath the side of a leaf, which it turns over and fastens with silk.

80. Melanthes otreus jamaicensis.

Papilio otreus Cram., Pap. Ex., iv, Tab. 328.
Ephyriades otreus Draudt in Seitz, Macrolep., v, p. 878, Pl. 172*a*; Longstaff, Trans. Ent. Soc. Lond., 1908.
Oleides zephodes Hüb. Samm. Exot. Sch. (1816–1841), Pl. 151, ff. 1–4.
Melanthes zephodes Draudt in Seitz, Macrolep., v, p. 918, Pl. 178*i*.
Melanthes brunnea Draudt in Seitz, v, p. 918.
Melanthes jamaicensis Moesch., Zool.-Bot. Ges. Wien, 1878, p. 226.

Range. Cuba, Bahamas (Nassau), Jamaica, Hayti, Honduras, Trinidad, Guiana.

A mountain butterfly. Newcastle, 4700 ft., June 1919 (*F. W. Jackson*); Sta Cruz Mts., 2000 ft. Chancery Hall,

Constant Spring (*G. B. Longstaff*). Sexually dimorphic. The males sometimes completely black with only a minute white dot in apex. The female is quite different, with considerable mottling and with two irregular lines of transparent spots and dots in apical area.

Subfamily *PAMPHILINAE.*

81. **Catia vesuria.**

Catia vesuria Plötz, Ex. Schmett., 20, Hesp., Tab. 876; Draudt in Seitz, Macrolep., v, p. 933, Pl. 181, f.; Longstaff, Trans. Ent. Soc. Lond., 1908, p. 50.
Catia drurii Longstaff, *id.*

Range. Jamaica, Cuba, Hispaniola.

The last two localities on the evidence of Mr. A. Hall. I have seen no specimen from these islands. Not at all rare and varies in the ground-colour considerably.

Localities. Cinchona, 5000 ft.; Newcastle, 4000 ft.; Bath, sea-level. The species covers a large range of altitude occurring from sea-level up to beyond 4000 ft.

82. **Hylephila phylaeus.**

Papilio phylaeus Drury, Ill. Ex. Ent., Pl. 13, f. 4, 5 (1773).
Hylephila phylaeus Draudt in Seitz, Macrolop., v, p. 928 (1924); Longstaff, Trans. Ent. Soc. Lond., p. 51 (1908).
Hylephila phylaeus (!) Panton, Jour. Inst. Jam. (1897), p. 440, Pl. 1 ff. 7–10 (life-history).

Range. Southern United States to Argentina, and all the West Indies.

An abundant species in the lowlands and up to 4000 ft. It is common at Newcastle at the latter elevation. Panton says it is common everywhere in the island, and that the larva feeds on the "running grass" *Paspalum conjugatum* and on *Panicum sanguinale.*

The description of the mature larva is as follows:—

"Length 32 mm. by 5 mm. wide. Head moderate size, dark brown. Colour of body now slightly lighter, with the brown lateral and dorsal stripes showing more distinctly. Spiracles hardly visible. Just prior to entering the pupa state the larva becomes somewhat greenish, especially laterally and on under surface."

83. Thymelicus vibex.

Thymelicus vibex Hübn., Znt. Ex. Schmett., f. 685, 686 (1832); Draudt in Seitz, Macrolep., v, p. 931; Longstaff, Trans. Ent. Soc. Lond., 1908, p. 51.

Range. Mexico to Colombia and Venezuela, Trinidad, Cuba, Hispaniola.

Less common than *Hylephila phylaeus*, which it somewhat resembles. Longstaff records a female coming to light at Montego Bay.

84. Limochores insolita.

Limochores aurinia Plötz, Stett. Ent. Zeit. (1883), p. 398. Draudt in Seitz, Macrolep., v, p. 935, Pl. 181*k*.

Pamphila insolita Butl., P.Z.S. Lond., 1878, p. 483; Longstaff, Trans. Ent. Soc. Lond., 1908, p. 50.

Range. Jamaica.

This is evidently a rare species. I have had no specimens of it. Longstaff took one of each sex at Park Mount, Port Antonio, in 1907.

85. Calpodes ethlius.

Papilio ethlius Cram., Pap. Ex., iv, p. 212 t. 392, f. A, B.

Calpodes ethlius Scudd. Butt. E.U.S. and Canada, ii, p. 1750, t. 17, f. 14; Watson, P.Z.S., 1893, p. 105; Godm., P.Z.S. (1896), p. 520; G. & S., Biol. Cent.-Am. Rhop., ii, p. 507, Pl. xcv, ff. 45, 46 (1900); Draudt in Seitz, Macrolep., v, p. 944, Pl. 183*c*.

Range. S.E. States of U.S.A. to the Argentine Republic, Cuba, Jamaica, Porto Rico, Dominica, Grenada, St. Vincent, Trinidad, Hispaniola.

Not very common in Jamaica apparently.

"Larva. Green, before the pupation across the dorsum lilac brown, watered white, the head beneath very broad, above somewhat indented, the os, a triangle above it and two punctiform spots at the sides of the frontal vesicle black. In funnel-shaped leaves of *Canna*. Pupa green, on the frons a spine-like, curved appendage. The case of the sucker projects beyond the apex of the abdomen by $1\frac{1}{2}$ to 2 cm.; it yields the imago in 10 to 20 days." Food-plant, *Canna*.

86. **Prenes ares.**

Hesperia ares Feld., Verh. Zool. Bot. Ges., xii, p. 477, n. 65 (1862).

Prenes ares Draudt in Seitz, Macrolep., v, p. 949 (1924).

Prenes ares Godm., Biol. Cent.-Am. Rhop., ii, p. 510; Longstaff, "Butt. Coll. in Many Lands," p. 289, 1912; and Trans. Ent. Soc. Lond., 1908, p. 48.

Range. Mexico to N. Brazil. Cuba, Hispaniola, Grenada, Trinidad, Porto Rico, Domenica, St. Vincent.

Not rare. Castleton, Aug. 1898 (*W. J. Kaye*), several specimens. Also in other localities. Probably common, as the larva feeds on the sugar cane. But it never seems to become sufficiently common anywhere to be called a pest.

87. **Prenes nero fufidia.**

Prenes fufidia Hew., Ann. Mag. Nat. Hist., p. 81 (1877).

Prenes nero fufidia Draudt in Seitz, v. p. 948, Pl 183*h*.

Prenes nero Godm., Biol. Cent.-Am. Rhop., i, p. 509, Pl. xcvi, ff. 4 ♂, 5, 6 ♀; 7 var. *corrupta*.

Hesperia nyctelius Latr., Enc. Méth., ix, p. 746 (1823); Longstaff, "Butt. Coll. Many Lands," p. 289, and Trans. Ent. Soc. Lond., 1908, p. 48.

Range of species. Mexico to Brazil, Cuba, Jamaica, Porto Rico, Trinidad, Domenica, Grenada, St. Vincent, Hispaniola.

Range of subspecies. Cuba, Haiti, Porto Rico, Dominica, Jamaica.

A very common species from sea-level up to 5000 ft. all over the island.

88. **Pyrrhocalles antiqua jamaicensis.**

Pamphila antiqua H. S., Corresp. Blatt. Regens., xvii, p. 142 (1863); Draudt in Seitz, Macrolep., v, p. 947, Pl. 183*f*, *g*.

Phemiades jamaicensis Schs., Proc. U.S. Nat. Mus., 1902, p. 440; Draudt, *l.c.*, p. 956.

Range of species. Hispaniola, Jamaica, Cuba.

Range of subspecies. Jamaica.

Well distributed and found from 1000–5000 ft. Long Mountain, Mona common, Mandeville, Moneague hotel gardens, feeding on a *Bougainvillea*. Stony Hill (*F. W. Jackson*); Newcastle, Bath, Aug. 1898 (*W. J. Kaye*);

Blue Mountains, July 1919, 1700 ft. (*F. W. Jackson*); Cinchona, 8.vii.99 (*P. I. Lathy*). The most striking Skipper in Jamaica, and at once recognised by the rich reddish-ochre colouring.

89. Morys valerius.

Apaustus valerius Moesch., Verh. Zool.-Bot. Ges. Wien, p. 223 (1878).
Pamphila cerdo Bdv., ? nom. MS. in B.M.
Morys valerius Draudt in Seitz, Macrolep., v. p. 962; Godm., Biol. Cent.-Am. Rhop., ii, p. 542, Pl. xcviii, ff. 45–47; Longstaff, Trans. Ent. Soc. Lond., 1908, p. 51.

Range. Mexico to Colombia, Venezuela and Amazons.

One of Jamaica's commonest butterflies. Castleton, Nov. Dec. '98, Newcastle, Bath, Aug. 1898 (*W. J. Kaye*). Probably to be found in every month of the year.

90. Cymaenes silius.

Hesperia silius Latr., Enc. Méth., ix. p. 764, n. 103 (1823).
Cymaenes silius Draudt in Seitz, Macrolep., v. p. 983 (1924); Longstaff, Trans. Ent. Soc. Lond., 1908, p. 51.

Range. Mexico to Brazil, Cuba.

Longstaff records the species from a wood above the jam factory at Constant Spring. I have not been able to examine any Jamaican specimen. Cuban ♂ specimens appear to be uniformly smaller and rather more distinctly marked above than those from the mainland. The undersides vary considerably from well-banded hind-wing to very indistinct banding.

91. Perichares corydon.

Papilio coridon Fab., Syst. Ent., p. 533, n. 385 (1775).
Hesperia phocion Fab., Syst. Ent., iii, 1, p. 335, n. 274 (1793).
Hesperia adela Hew., Ex. Butt., iv, Hesp., t. 1, ff. 1 3 (1867).
Perichares marmorata Rep., Peab. Acad., iv, p. 81 (1872).
Telegonus trinidad Lucas, Sag. Hist. Cuba, vii, p. 626.
Perichares trinidad, Draudt in Seitz, Macrolep., v, p. 995, Pl. 192*a*.
Perichares corydon Draudt, in Seitz, *l.c.*

Carystus corydon Panton, Journ. Inst. Jamaica, vol. ii, 5, p. 438 (life-history), 1897.

Range. Tropical America with most of the West Indian Islands, Trinidad, Cuba, Hispaniola.

An abundant species occurring from sea-level up to 3000 ft.

Panton has given in the Journal of the Institute of Jamaica for 1897 a full account of the life-history of this common species. He there says that the imagines always hatch from the pupæ at night. Also that he has observed the female laying her eggs late in the evening in January and February in the Clarendon Mountains at 3000 ft. "The egg is laid singly, is sometimes placed on the under-surface of the leaf-blade near the edge, and in other instances on the upper-side near the midrib or otherwise placed at random." The food-plants of the larvæ are sugar-cane, Indian corn and the grass *Panicum maximum*.

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XIX. *A remarkable new Dragonfly from Samoa.* By Major F. C. Fraser, M.D., I.M.S., F.E.S.

[Read October 21st, 1925.]

Plate XLIX.

Included in a collection of Odonates made recently by Dr. J. S. Armstrong in Samoa, are two specimens of a very remarkable dragonfly, whose position lies close to the genus *Ischnura*. The new species agrees in having the pterostigma of fore- and hind-wings different, and also in having a raised bifid projection at the apical border of the dorsum of segment 10; but, whereas in *Ischnura* we find the differences between the two pterostigmata more of a chromatic nature, in this new species we note that the pterostigma of the fore-wing is of a totally different shape to that of the hind, and, moreover, that it extends into the wing, with a resultant altering in shape of the apex. The anal appendages, which are of a simple nature in the genus *Ischnura*, are, in the new species, very complex, and taken together with the characters of the wings, already mentioned, necessitate the creation of a new genus to accommodate it.

Pacificagrion gen. nov.

Moderate-sized insects, considerably larger than any known *Ischnura*; petiole of wing not extending as far distad as the nervure *ac*, which lies nearly midway between the two antenodal nervures; arc arising opposite the distal antenodal; fore-wing with apex markedly falcate, hind-wing normal; pterostigma of fore-wing leaving the costa and curving into the wing, shaped like an elongate tear-drop, that of the hind-wing normal; quadrilateral acute and shaped similarly in fore- and hind-wings; 10th segment ending apicad with a bifid projecting tubercle; anal appendages highly specialised, the superior chelate, inferior tapering.

Pacificagrion lachrymosa sp. nov.

Male. Abdomen 31–32 mm. Hind-wing 22 mm.

Head: labium white; labrum blue, broadly black at base; clypeus black, edged narrowly in front with pale blue; cheeks blue, this colour extending up and across frons, but not quite confluent

at the middle; rest of head black with large blue postocular subtriangular spots.

Prothorax black with a small spot of blue on each side.

Thorax black on dorsum, with narrow humeral blue stripes, slightly constricted near the upper part. The sides blue with a broad black stripe on the postero-lateral suture.

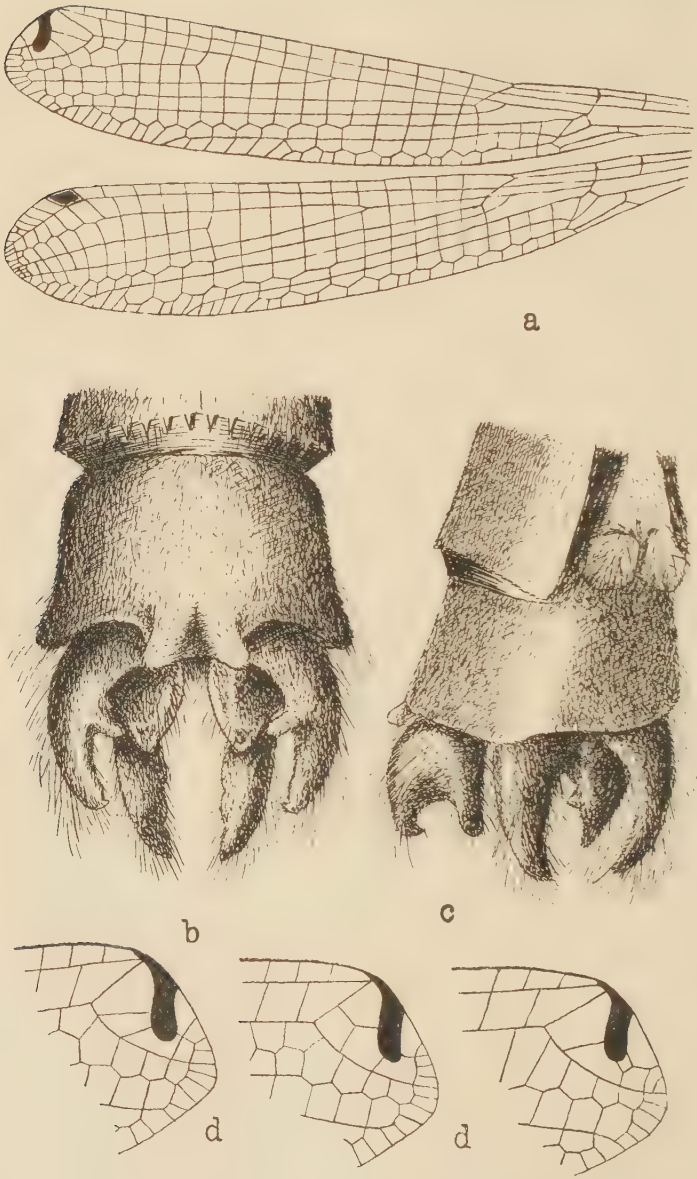
Legs black, femora bluish on the flexor surface, femoral and tibial spines short, robust, 6 to 7 in number.

Abdomen black; 1st segment broadly blue on the sides, 2nd with a narrow subventral blue stripe, the joint between segments 1 and 2 pale blue, segments 3 to 7 with minute paired dorsal blue spots separated by the black middorsal carina, a small basal lateral blue spot on each side of all these segments, segments 8 and 9 broadly blue on the dorsum, this colour extending squarely down on the sides for about the apical half of 9 and the apical third of 8, segment 10 unmarked save for a fine latero-ventral stripe of blue. The lateral markings on segments 8 and 9 somewhat variable; in one specimen, the blue not extending to the ventral border; in another, the ventral border blue and connected apicad to the dorsal blue by a narrow isthmus.

Anal appendages black. Superiors shaped roughly like a hand with two fingers and a thumb, the palmar part tapering to a blunt incurved spine, with a small robust digitate spine on the middle of its upper and inner border, the thenar part broadly triangular and hollowed out. Inferiors rather longer than superiors, thick at base, tapering to a blunt point, curved regularly inward. Process on dorsum of segment 10 projecting markedly apicad, shallowly bifid.

Wings hyaline; 17 to 18 postnodal nervures in the fore, 14 in the hind; pterostigmata black; that of fore-wing begins as a slight thickening at a premature fusion of the radius with the costa, and is continued for a short distance round the apex of wing. From this costal thickening a long curved process extends into body of wing, and is apparently supported by a bifurcation of the medius. This bifurcation is, however, brought about by the meeting of an elongated pterostigmal brace with the medius. (The supporting nervures of the pterostigma show a certain amount of variation as would be expected from such an abnormal structure.) Pterostigma of hind-wing diamond-shaped, its costal border longer than its inner, and its outer very oblique. Reticulation at apex of hind-wing closer than that of the fore-wing.

Type, deposited in the British Museum, from Malolelei, Upolu, W. Samoa, collected by Dr. J. S. Armstrong,



F. C. F. del.

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NEW SAMOAN DRAGONFLY.

3.vii.24. Amongst several females of unknown species which accompanied this insect, it has not been found possible to pick out one which is of even doubtful relationship to it.

Explanation of Plate XLIX.

Fig. *a*. Wings of *Pacificagrion lachrymosa* sp. nov.
b. Anal appendages of same seen from above.
c. The same seen from a ventro-lateral aspect.
d. Apices of fore-wings to show variable neuration.

XX. *A new Psychid* (Lepidoptera, Psychidae) *from South America.* By Frank Morton Jones.

[Read October 21st, 1925.]

Plate L.

Through the courtesy of the Director of the Imperial Bureau of Entomology, Dr. G. A. K. Marshall, C.M.G., F.R.S., F.Z.S., F.E.S., the writer has been privileged to study an interesting little Psychid from British Guiana, represented by three specimens of the adult male, three larval cases, and a male pupa-shell. This insect is smaller than any of the previously described Psychids of South America, and requires for its reception a new genus, for which is proposed the name,

Dendropsyche n. g.

Antennae bipectinate to tips, the branches diminishing in length apically from the middle; shaft and branches scaled. Legs slender, the first pair the longest, the third pair the shortest; no tibial spines or spurs. Wings opaque, rounded, with 11–7 veins; anal vein of fore-wings without a branch towards inner margin, 1*b* and 1*c* anastomosing beyond middle, thence coincident and straight to outer margin; veinlet in cell (both wings) not furcate at the cross vein; 7 and 8 of hind-wings separate, or faintly connected in basal third.

The genotype is

Dendropsyche burrowsi n. sp.

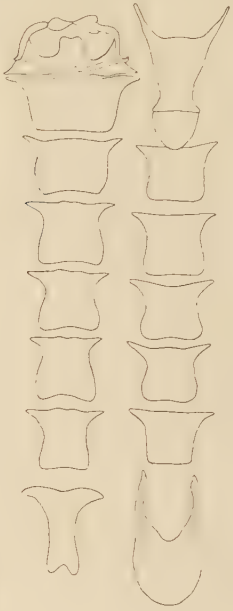
Adult ♂.—A slender frail insect, of a uniform smoky brown, with hairy body-vestiture. The antennae have (about) 18 joints. Length of fore-wing, 5·5 to 5·75 mm.; of hind-wing, 3·5 to 4 mm. None of the veins are stemmed to the cell; 4 and 5 are close together and almost parallel from cell to margin; when present, the oblique bar connecting 7 and 8 of the hind-wing is very weak, and in some examples it is present in one wing, absent in the opposite one; the wing-scales are narrow and hair-like. The genitalia are narrow and elongated, the saccus being exceptionally long and slender; the furcate ventral plate of the eighth abdominal segment is well developed, its rods slightly arched and about as long as the basal

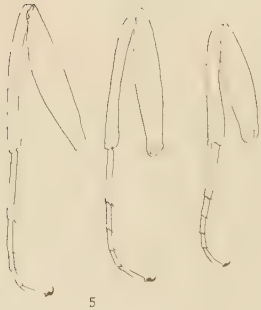
portion of the plate; the opposite dorsal plate is unusually large and strong, and has a medial notch on its caudal margin.

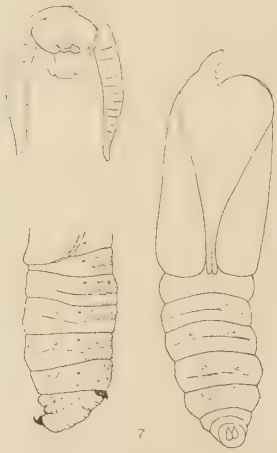
Larval case.—Length, 10 to 12·5 mm.; widest at the collapsible mouth (2·5 to 4 mm.), thence tapering to a diameter of about 1 mm. at the distal end. Many small fragments of vegetable matter (principally bark) are embedded or partially embedded in the silk; on the widened flexible mouth these fragments are larger and less enswathed in the silk, than on the firm-textured tapering tubular portion, where they scarcely project above the surface. The case is probably carried upright,—not suspended,—by the living larva.

Pupa of ♂.—Length, 5·5 mm. Dull dark brown to yellowish amber-brown; the head, the thoracic segments, and the cephalo-dorsal halves of the free abdominal segments, are brownish amber; the caudal halves of abdominal segments 3, 4, 5, and 6 (and narrowly on 7) are dull dark brown, contrasting with the yellowish amber of the remaining abdominal area. The broad antennae terminate at 3/5 the distance from the vertex to the margin of the wings, which ventrally overlap much of the third abdominal segment. The prothoracic legs exceed the antennae, and the metathoracic legs reach the wing-margin. The labial palpi exceed the maxillae. The spiracles are slightly raised above and concolorous with the surrounding areas. The caudal segments are curved ventrad, and bear the usual pair of chitinised hooks, which are darkened in colour and strongly curved. The dorso-cephalic portions of the abdominal segments are finely striate, and each, from 3 to 8 inclusive, bears a spined ridge with caudad-directed teeth, vestigial on 3 and 4, progressively more prominent on 5, 6, 7, and 8, on the latter consisting of four teeth which with their fused bases form a narrow projecting comb-like plate. Each of segments 4 and 6 bears a dorso-caudal row of cephalad-directed fine spines. In conformity with its enclosing cocoon, the pupa approaches the cylindrical in form.

The type material, deposited in the British Museum collection, bears labels showing that it was collected and bred at Georgetown, British Guiana, by G. E. Bodkin (one label reads, "On bark of lime trees"), the indicated emergence dates of the moths being in October, December, and January. Of the three moths available for study, a pinned specimen in fair condition is designated as the holotype; the paratype material consists of a partially dissected pinned specimen, micro slides prepared from this and from the third available male, and of the early-stage specimens already enumerated.







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DENDROPSYCHE BURROWSI.

By Hampson's tables, *Dendropsyche burrowsi* falls into the subfamily Chaliinae, genus *Pteroxys* ; but *Pteroxys* has furcate cell-veins, and presents other wide differences. The presence or absence of a branch from the anal vein of the fore-wings, diverging towards the inner margin, has not, necessarily, subfamily significance; and although this character separates *Dendropsyche* from the Psychinae as usually defined, in this instance the nearer allies of the genus and species are to be looked for among those Western Hemisphere insects which have been referred to various genera of this subfamily. From *Prochalia* B. & McD., *Zamopsyche* Dyar, and the misplaced *Chalia rileyi* of Heylaerts, *Dendropsyche* is separable by its unspined fore tibiae as well as by its venation; like these and most other small Psychids of the Western Hemisphere (*symmicta* Dyar, *celibata* Jones), it unquestionably belongs to the so-called " higher " Psychids, and not to those other groups of which this whole region seems to be so peculiarly destitute.

Named in honour of the veteran student of the Psychids, the Rev. C. R. N. Burrows, to whom the writer is indebted for numberless courtesies and most generous assistance.

Explanation of Plate L.

Dendropsyche burrowsi n. g. and n. sp.

Fig. 1. Venation, wings of ♂.
2. Genitalia of ♂.
3. Dorsal and ventral abdominal plates of ♂.
4. Typical wing-scales.
5. Legs of ♂, denuded.
6. Larval case.
7. Pupa of ♂.

XXI. *Contribution à la Faune des Orthoptères des Nouvelles-Hébrides.* Par C. Willemse, Eygelshoven, Hollande. Avec une introduction de John R. Baker. Communicated by Prof. E. B. Poulton, F.R.S.

[Read October 21st, 1925.]

Plate LI, and Five Text-figures.

Introduction.

En introduisant l'article de Mons. C. Willemse concernant les Orthoptères que j'ai collectionnées aux Nouvelles-Hébrides, je désire avant tout exprimer mes remerciements aux Trustees of the Percy Sladen Memorial Fund qui m'ont procuré les moyens pécuniaires de mon voyage d'études.

Je suis également l'obligé de Mons. le Professeur E. B. Poulton qui m'a aidé tant qu'il lui était possible, non seulement pour la collection d'Orthoptères, mais également pour celle d'autres groupes d'insectes, en surveillant leur conservation, le libellement des localités d'origine et la distribution aux autorités compétentes pour la détermination et les descriptions.

Je n'oublie pas non plus Mons. et Mdme. Anderson qui m'ont si largement offert une généreuse hospitalité pendant mon séjour à l'Ile de Espiritu-Santo.

Les Nouvelles-Hébrides forment une groupe de petites îles montagneuses à l'ouest de l'Océan Pacifique, à l'est de la Nouvelle-Calédonie et à l'ouest de l'île Fidji.

Les montagnes sont en tuf volcanique et en corail surélevé.

Le climat y est tropical et les pluies abondantes (environ 170 inches par an sur une île où elle a été mesurée).

Il n'y a que peu de différence entre la saison chaude avec beaucoup de pluie et la saison moins chaude avec peu de pluie.

La végétation luxuriante forme des forêts impénétrables de petits arbres, principalement.

Les espaces dénués d'arbres se présentent seulement dans les parties cultivées des îles.

La collection a été formée en la saison chaude 1922–23.

Préface.

La connaissance de la faune orthoptérologique des Nouvelles-Hébrides a été enrichie ces dernières années par le résultat des explorations de MM. les Drs. F. Sarasin et J. Roux, publié dans la " Nova Caledonia." *

Par les recherches de Mons. J. R. Baker, spécialement dans les Nouvelles-Hébrides, la connaissance a été augmentée et la collection comprend 83 exemplaires représentant 22 genres et 27 espèces, parmi lesquelles se trouvent un nouveau genre et 6 nouvelles espèces.

Je tiens à exprimer mes remerciements à Mons. le Prof. E. B. Poulton pour l'amabilité qu'il a eue en me confiant l'étude de cette collection et de même à Mons. B. P. Uvarov qui avait déjà déterminé une partie et particulièrement à Mons. L. Chopard qui a eu la bonté de déterminer et de reviser les Gryllides.

Fam. MANTIDAE.

Sous-fam. *MANTINAE.*

Tenodera australasiae Leach.

Localité : New Hebrides, Efate Island, Dec. 1922; Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 16, 1923, 1 ♂.

Statilia apicalis Saussure.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 18, 1923, 1 ♀.

* *A. Griffini :* Stenopelmatidae della Nuova Caledonia, 1914.
H. Karny : Conocephalidae Neucaledoniens und der Loyalty Inseln, 1914.
L. Chopard : Gryllidae de la Nouvelle-Calédonie et des Iles Loyalty, 1915.
C. Willemse : Locustidae (Acridiidae a-a-) et Phasgonuridae (Locustidae a-a) de la Nouvelle-Calédonie et des Iles Loyalty, 1923.
L. Chopard : Blattidae de la Nouvelle-Calédonie et des Iles Loyalty, 1924.

Couleur du corps brun (verdâtre ?). Les taches sous les hanches et fémurs antérieurs sont vertes ayant un éclat métallique.

Longueur du corps	35 mm.
„ du prothorax	12 „
Largeur du pronotum	3 „
Longueur de l'élytre	26 „
„ de l'aile	25 „ *

Fam. PHASGONURIDAE.

Sous-fam. *COPIPHORINAE.*

Euconocephalus extensor Walker (= australis Bol.).

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 10, 1923, 2 ♂♂. Pl. LI, fig. 1.

Longueur du corps	36 mm.
„ du fastig. vertic.	2·5 „
„ du pronotum	9 „
„ de l'élytre	41·5 „
„ du fémur postérieur	23 „

Sous-fam. *CONOCEPHALINAE.*

Xiphidion affine Redt.

Localité : New Hebrides, Espir.-Santo Isl. (Chuuri,† 1000 2000 ft.; Hog Harbour, open forest), Jan. 7 25, 1923, 6 ♂♂, 4 ♀♀.

Xiphidion laetum Redt.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings; Chuuri), Jan. 1923, 1 ♂, 1 ♀.

Xiphidion geniculare Redt.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 9, 1923, 1 ♂; idem (open forest), Jan. 7, 1923, 1 ♀.

Sous-fam. *LISTROSCELINAE.*

Phisis listeri Kirby.

Localité : New Hebrides, Jan. 23, 1923, 0–500 ft., Espir.-Santo Isl., 1 ♂; idem, Jan. 22, 1923, 1 ♀, Espir.-Santo Isl. (Shark Bay, clearings).

* Saussure indique la longueur de l'aile chez le ♂ comme 1·3. Ce doit être une erreur.

† Chuuri is a village in the centre of the island.—J. R. B.

Cette espèce est voisine à *Ph. pectinata* Guérin, mais en diffère par les bords jaunes du pronotum et l'oviscapte qui est plus petite.

En voici les dimensions :—

	♂.	♀.
Longueur du corps . . .	13 mm.	14 mm.
„ du pronotum . .	3 „	3·5 „
„ de l'élytre . .	20 „	20·5 „
„ du fémur antér. .	5·5 „	5 „
„ du fémur postér. .	—	11·5 „
„ du tibia antér. . .	5·5 „	5·5 „
„ de l'oviscapte . .	—	9 „

Le nombre des épines aux pattes antérieures et intermédiaires est comme suit :—

	♂.	♀.
Fémur antérieur face interne . . .	4	5
„ „ „ externe . . .	6	6
„ intermédiaire face interne . . .	0	0
„ „ „ externe . . .	4	3
Tibia antérieur face interne . . .	7	6
„ „ „ externe . . .	7	7
„ intermédiaire face interne . . .	6	6
„ „ „ externe . . .	6	5

Dans la collection se trouve aussi un ♂ larve de *Phisis*, du même endroit (Esp.-Santo I. (Hog Harbour, clearings), Jan. 11, 1923), qui appartient probablement à la même espèce.

Sous-fam. *AGRAECIINAE*.

Salomona magnifica nov. sp.

La couleur générale est d'un brun noirâtre avec des parties jaunes.

La tête est un peu moins large près des yeux que près des mandibules.

L'éperon frontal est assez grand, il n'atteint pas la hauteur du premier article des antennes, il est acuminé à l'extrémité, et offre en dessus à la base un petit tubercule, en dessous dans le midi un grand tubercule plus ou moins arrondi.

Le front est rugueux en avant, mais moins sur les joues; là, on peut distinguer des saillies; une crête un peu confuse part de l'œil, se bifurquant au milieu de la joue, et les deux branches ainsi formées atteignent, l'une l'angle antérieur, l'autre l'angle postérieur des mandibules. Derrière cette crête on aperçoit encore une branche, mais plus faible, sortant de l'œil et se réunissant avec la branche postérieure.

La partie postérieure des joues est à peu près lisse.

La tête est d'un brun jaunâtre, le vertex noir, sauf une tache centrale parfois composée de 3–4 petites taches, jaune.

L'éperon frontal, ainsi que les deux premiers articles des antennes, une ligne autour des yeux, réunies sur le front sont noirs.

De cette ligne sort une tache quadrangulaire noire sur le front parfois se terminant en deux lignes noires.

Le front d'un brun jaunâtre ou rougeâtre, les joues plus claires; la partie inférieure du front noire; le clypeus jaune, les mandibules puissantes et noires, les mâchoires, le labium sauf la partie supérieure qui est noire, les palpes maxillaires et labiaux sont jaunâtres.

Les antennes sont d'un jaune pâle, sauf les deux premiers articles qui sont d'un noir brillant.

Toutes les pièces sternales sont d'un brun noir.

Le pronotum, tronqué et peu prolongé en arrière, offre de grosses ponctuations sur toute la surface, sauf au milieu, sur une tache longitudinale lisse et jaunâtre et sur deux grosses saillies latérales et irrégulières qui sont jaunâtres et striées finement longitudinalement. Le pronotum est partout ailleurs d'un brun-noir brillant.

Les élytres sont d'un brun pâle, avec les veines et nervures d'un joli vert ou plutôt brun, avec des petites taches brunes peu nombreuses et irrégulièrement disposées sur la surface.

Les ailes presque incolores ou légèrement enfumées.

Les pattes d'un brun-noir, les hanches avec une tache jaunâtre, les fémurs sur la face interne avec une coloration jaunâtre surtout à la base; les tibias d'un brun-noir, plus pâles à l'extrémité, les tarses jaunâtres, l'insertion des articles noire.

L'abdomen est d'un brun pâle, et les stigmates sont d'un brun foncé.

La carène interne du fémur postérieur est sans épines.

♂. Le dernier segment dorsal est échancré au milieu et déprimé, avec les lobes arrondis.

Les cerci sont épais, recourbés en dedans à l'extrémité, presque cylindriques à apex obtus, présentant à la base à la face interne un lobe assez large plus ou moins carré et tronqué.

La plaque sous-génitale assez longue, offrant une incision triangulaire portant des stylets de longueur moyenne.

♀. Les cerci courbés régulièrement et plus ou moins croisés, l'apex arrondi.

L'oviscapte courbé régulièrement, falciforme, brun-noirâtre.

La plaque sous-génitale courte, montrant au sommet deux lobes.

	♂.	♀.
Longueur du corps . . .	54 mm.	52–56 mm.
„ du pronotum . .	13 „	12–13 „
„ de l'élytre . . .	37·5 „	43–44 „
„ du fémur postér. . .	20 „	23 „
„ de l'oviscapte		19 „

Localité : New Hebrides, Espir.-Santo Isl. (open forest), Jan. 8, 1923, 1 ♂ (type); idem 1 ♀; Elephant Isl. (open forest), Jan. 12, 1923, 1 ♀. Pl. LI, fig. 2, text-fig. 1.

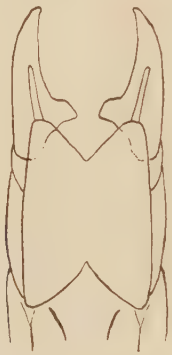

Fig. 1.—*Salomona magnifica* nov. sp. ♂.
Plaque sous-génitale et cerci en dessous.

Cette espèce vient se placer près de *laticeps* de Haan, dont elle diffère par la coloration de la tête qui chez *laticeps* est tout à fait noire excepté le clypeus et labrum.

Fam. GRYLLACRIDAE.

Gryllacris punctipennis Walker.

Localité : New Hebrides, Espir.-Santo Isl. (Shark Bay, clearings), 1923, 1 ♂, 2 ♀♀. Pl. LI, fig. 4.

Gryllacris poultoni * nov. sp.

Corps assez robuste, de taille moyenne. Couleur du corps brun-jaunâtre.

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* En honneur de Mons. le Prof. E. B. Poulton, le célèbre entomologiste de l'université d'Oxford. Ne pas confondre avec le *Gryl. poultoniana* Griff.

Le vertex avec un demi-cercle noirâtre autour de chaque œil et quelques petites taches brun-foncées.

Fastigium verticis plus large que le 1er article de l'antenne, avec des lignes noirâtres dans le milieu, étant le bout des demi-cercles.

Les taches ocellaires rougeâtres, la tache frontale ovale.

Entre les antennes avec 2 petites taches noires.

Front avec une ligne brun-foncée diagonale, au-dessous de l'insertion de l'antenne, et avec un point noir à chaque côté.

Le clypeus avec quelques points foncés.

Les mandibules brun-rougeâtres, le bord interne noirâtre.

Pronotum brun-jaunâtre avec quelques points et lignes brun-foncés comme indique la figure, le bord antérieur dans son milieu avancé et arrondi, rougeâtre ou plus clair, le reste du bord antérieur, le bord inférieur et le bord postérieur noirâtres ou brun-foncés.

L'angle antérieur du lobe réfléchi arrondi, l'angle postérieur sinueusement arrondi.

Les élytres atteignent le bout de l'abdomen, les ailes un peu plus longues.

Élytres subhyalines, les nervures d'un brun léger, les cellules, surtout de la partie postérieure, brun-foncées, formant un contraste distinct avec les nervures.

La nervation d'après le type III *b* (Karny).

Nervure radiale libre, ramifiée, le secteur rad. se détachant dès le milieu, celui-ci près de l'apex une fois ramifié.

Nervure médiane simple, non confondue avec les autres.

Nervure cubitale ramifiée deux fois, dans le tiers basilaire et dès son milieu.

Les six nervures anales simples.

Aile de forme triangulaire, hyaline, avec 5–6 bandes brunes irrégulières et incomplètes, parallèles au bord postérieur, les nervures de coloration brun-léger, les bandes situées dans les cellules de sorte que les nervures sont bordées d'une zone hyaline.

Les pattes brun-jaunâtres, les fémurs en dessous d'un bleu acier.

Fémur postérieur à son bord inférieur externe avec 9 épines, à son bord inférieur interne avec 7–8 épines, bleu acier.

Les tibias antérieurs et intermédiaires avec une double rangée de 4 épines mobiles, d'une même couleur que le tibia.

Tibia postérieur avec 8 épines au bord interne et 8 épines au bord externe. Les épines à l'apex plus foncées.

Les tergites brun-foncés, luisants, les sternites brun-jaunâtres.

Oviscapte falciforme, brun. Plaque sous-génitale à bord postérieur simplement arrondi.

	♀.
Longueur du corps	27 mm.
„ du pronotum	5·5 „
„ de l'élytre	18 „
Latitude de l'élytre	7·5 „
Longueur du fémur ant.	8 „
„ du fémur post.	12·5 „
„ de l'oviscapte	12 „

Localité : New Hebrides, Espir.-Santo Isl., Elephant Isl. (open forest 0–100 ft.), Jan. 12, 1923, 1 ♀ type. Pl. LI, fig. 3.

Fam. GRYLLIDAE.

Sous-fam. *GRYLLINAE.*

Gryllus oceanicus Le Guillon.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 1923, 1 ♂.

Mons. L. Chopard m'écrit * : " *Gryllus oceanicus* Le Guillon, c'est l'espèce que j'ai signalée déjà des N^lles Hébrides sous le nom de *Gr. commodus* Walk. (Nova Caledonia, II. 8, p. 166)."

Sous-fam. *TRIGONIDIINAE.*

Metioche flavipes Sauss.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 5, 1923, 1 ♂; Efate Isl. (Vila, clearings), Dec. 1922, 1 ♂, 3 ♀♀; idem (Meli, Nat. Gardens), Dec. 14, 1922, 1 ♀.

Mons. L. Chopard m'écrit : " *Metioche flavipes* Sauss. est, à mon avis, la forme brachyptère de *M. vittaticollis* Stål."

Paratrigonidium fuscocinctum Chopard.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 9, 1923, 1 ♂, 1 ♀; Efate Isl. (Vila, clearings), Dec. 22, 1922, 1 ♂; Banks Isl. (Gaua, Nombu, dense forest), Nov. 18, 1922, 1 ♀.

Mons. L. Chopard m'écrit : " *Paratrigonidium fuscocinctum* Chop., espèce de Java dont la description doit paraître dans " Treubia." Cette espèce se trouve aussi en Australie; les individus des N^lles Hébrides diffèrent du type par des antennes plus noires, mais cette différence ne me paraît pas spécifique."

* La lettre est datée 19 Mars 1925.

Sous-fam. *ENEOPTERINAE.*

Cardiodactylus novae-guineae de Haan.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 9, 1923, 1 ♂, 2 ♀♀ et 2 larves.

Cardiodactylus pictus Sauss.

Localité : New Hebrides. Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 5, 1923, 1 ♀.

Podoscirtus chopardi * nov. sp.

♀. Forme assez large, couleur brune ou roussâtre, le pronotum avec des bandes et taches irrégulières plus foncées, qui me semblent être produites par la dessiccation.

Tête bombée en dessus, subglobuleuse, le front arrondi; rostre aussi large que le 1er article des antennes, portant l'ocelle antérieur au fond d'une fossette, vers le milieu de sa longueur, muni de quelques soies.

Front court, un peu déprimé.

Yeux assez saillants en avant, ocelles petites.

Antennes brunâtres à 1er article grand, arrondi.

Palpes assez longs; palpes maxillaires à article III, IV et V à peu près égaux, le dernier dilaté au sommet et tronqué obliquement, son bord supérieur arqué; palpes labiaux à article III dilatés à l'extrémité.

Pronotum distinctement transversal, à bord antérieur droit, bord postérieur subarcé, tous deux ciliés.

Disque avec une ligne médiane faiblement indiquée; lobes latéraux étroits, obliques, le bord antérieur droit et cilié.

Abdomen court, chez la ♀ le dernier tergite abdominal normal, plaque suranale fortement carénée latéralement et rétrécie au milieu, plaque sous-génitale longue, échancrée à l'apex.

Cerques de la longueur de l'oviscapte, avec des poils longs.

Oviscapte dans la moitié apicale courbé. Valves apicales brun-noirâtres; les supérieures dépassant les inférieures, ridées obliquement à la face externe et présentant en dessous à la base, deux dents arrondies; de ces dents jusqu'à l'extrémité trois rangées de petites lames aplaties plus ou moins denticulées; valves inférieures à bord inférieur avec 4 petites dents aiguës, l'apex pointu.

* En honneur de Mons. le Dr. L. Chopard, le savant connaisseur des Gryllides.

Pattes antérieures et intermédiaires fortes, velues; fémurs un peu comprimés, tibias à épines très courtes, les antérieurs portant un tambour interne ovale, et un externe ovale un peu plus petit.

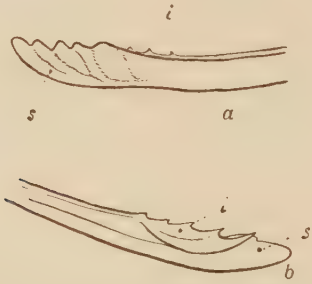

Fig. 2.—*Podoscirtus chopardi* nov. sp. ♀.
Extrémité de l'oviscapte.
a, face externe; *b*, face interne.
s = valve supérieure; *i* = valve inférieure.

Tarses courts; métatarse un peu plus long que le 2e article, qui est déprimé, cordiforme; 3e article un peu plus long que le métatarse, grêle.

Tarses intermédiaires et pattes postérieures manquant.

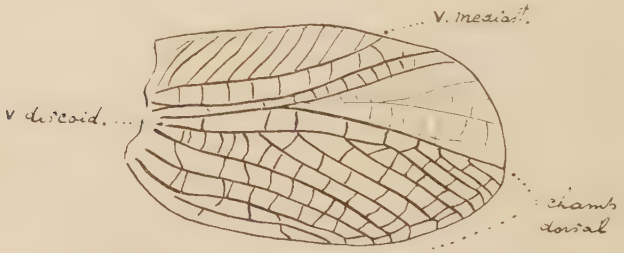

Fig. 3.—*Podoscirtus chopardi* nov. sp. ♀.
Élytre.

Élytres un peu plus longs que l'abdomen, jaune-brunâtres; champ dorsal présentant 4 nervures longitudinales et 4–5 branches à la discoïdale; nervules assez régulièrement espacées en carrés allongés; champ latéral assez large, présentant 2 nervures libres et 10–11 branches à la médiastine.

Ailes dépassant un peu les élytres.

Dimensions ; ♀.

Longueur du corps	12 mm.
„ „ avec élytres . .	15·5 „
„ „ avec ailes . . .	15·7 „
„ du pronotum	3 „
„ du fém. ant.	5 „
„ du tib. ant.	4·5 „
„ du fém. interm. . . .	4·5 „
„ du tib. interm. . . .	4·5 „
„ du fém. post.	? „
„ du tib. post.	? „
„ de l'oviscapte	12 „

Cette espèce se distingue des autres par la forme un peu large, par le grand nombre de branches à la nervure médiastine et par la forme de l'oviscapte.

Localité : New Hebrides, Espir.-Santo Isl. (open forest near Hog Harbour), Jan. 8, 1923, 1 ♀ type. Text-figs. 2*a*, 2*b*, 3.

Aphonomorphus punctatus de Haan.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 9, 1923, 1 ♀.

Fam. PHASMIDAE.

Sous-fam. *PHIBALOSOMINI.*

Megacrania bakeri * nov. sp.

♀. Verdâtre, varié de brun et de jaune. Occiput avec 4–5 lignes jaunâtres plus ou moins fort indiquées.

Les antennes brun-jaunâtres, à la base parfois verdâtres, l'apex un peu plus clair.

Mésonotum atténué postérieurement, la surface couverte de petites granulations ou tubercules peu nombreux, disposés plus ou moins en séries.

Le bord antérieur avec une dent à chaque côté.

Mésopleura et mésosternum lisse, ainsi que le métapleura et métasternum.

Élytres ovalaires, courts, dépassant peu la longueur du métathorax, bruns les nervures jaunâtres, à tubercule peu saillant.

Ailes beaucoup plus longues que les élytres, atteignant le bout

* En honneur de Mons. J. R. Baker, l'explorateur des Nouvelles-Hébrides.

du fémur postérieur, à champ antérieur brun à nervures jaunâtres; champ postérieur unicolore, presque incolore.

Abdomen brun-verdâtre, le bord postérieur des anneaux avec une bande assez large, brun-foncée.

Face inférieure du corps jaunâtre.

Le bord postérieur du segment anal simplement arrondi.

Cerci courts, aplatis, larges, à apex arrondis. Opercule atteignant le sommet des cerci, atténué et caréné dans son milieu. Pattes vertes.

Les carènes supérieures du fémur antérieur distinctement dentées. La carène médiane inférieure de tous les fémurs avec une rangée de 4–5 dents.

	♀.
Longueur du corps	108 mm.
„ de l'antenne	21 „
„ du mésonotum	16 „
„ du métanotum	11 „
„ du fémur antér.	25 „
„ du fémur interm.	15 „
„ du fémur postérieur	18 „
„ de l'opercule	17 „

Cette espèce vient se placer près de *M. alpheus* Westw. dont elle diffère par les carènes supérieures du fémur antérieur distinctement dentées.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 1923, 3 ♀♀, type et cotype, et une larve.

Sous-fam. *ACROPHYLLINI.*

Hermarchus novae-britanniae Wood-Mason.

	♂.
Longueur du corps	102 mm.
„ du mésonotum	20 „
„ du métanotum	12 „
„ de l'élytre	6·5 „
„ de l'aile	54 „
„ du fémur ant.	34 „
„ du fémur post.	29 „

L'exemplaire correspond assez bien avec la description que Redtenbacher (Die Insektenfamilie der Phasmiden III, 1908, p. 447) en donne. Puisque les ♂♂ de plusieurs espèces de *Hermarchus* ne sont pas connus, il est toujours difficile de les déterminer avec certitude.

La connaissance de plusieurs genres des Phasmiens, comme aussi de celui-ci, laisse encore beaucoup à désirer.

Localité : New Hebrides, Efate Isl. (Vila, clearings), Dec. 24, 1922, 1 ♂.

Fig. 4.—*Hermarchus uvarovi* nov. sp. ♀.
Méso- et métasternum en dessous.

Hermarchus uvarovi * nov. sp.

♀. Robuste, jaunâtre varié de brun.

Occiput lisse, avec quelques lignes longitudinales, impressées. Pronotum avec le sillon typique au milieu, le disque avec des lobes peu élevés.

Prosternum s'élargissant en arrière, le bord latéral avec une petite dent près du bord postérieur.

* En honneur de Mons. B. P. Uvarov, le célèbre orthoptérologiste du Mus. Nat. Hist. de London.

Mésonotum lisse, portant aucune dent, un peu renflé vers le tiers antérieur et atténué antérieurement dès le tiers antérieur.

Mésopleura avec une rangée de 8–9 dents bien indiquées dans la partie postérieure.

Mésosternum presque lisse, avec quelques denticules, irrégulièrement disposées.

Métanotum lisse. Métapleura avec une rangée de 4–6 dents assez grandes. Métasternum lisse.

Abdomen lisse, atténué régulièrement vers le bout, les bords latéraux des segments non dilatés.

Le bord postérieur de la plaque suranale arrondi. Cerques courts, un peu comprimés et courbés, plus ou moins pointus au sommet.

Opercule très long, dépassant bien le bout de l'abdomen, tectiforme, atténué, subarrondi à l'apex.

Valvules de l'oviscapte dépassant le bout de l'opercule, filiformes.

Pattes fortes.

Fémurs antérieurs à carènes supérieures finement denticulées, les carènes inférieures fortement denticulées.

Les carènes du tibia antérieur finement denticulées, la carène inférieure, latérale, plus forte.

Les carènes des fémurs intermédiaires et postérieurs, ainsi que les tibias plus fortement denticulées, sauf les carènes supérieures des tibias qui sont finement denticulées.

La face inférieure des fémurs et tibias dans le milieu avec une rangée de dents plus ou moins fortes.

Métatarses denticulés.

	♀.
Longueur du corps	172 mm.
„ de l'antenne	60 „
„ du mésonotum	36 „
„ du métanotum	22 „
„ du fémur antér.	47 „
„ du fémur interm. . . .	36 „
„ du fémur postérieur . . .	40 „
„ de l'opercule	27 „

Localité : New Hebrides or Banks Island. Sept. 1922–Jan. 1923, 1 ♀ type. Text-fig. 4.

Cette espèce vient se placer près de *H. inermis* Redt. dont elle diffère par le mésopleura qui porte une rangée de grandes dents, tandis que dans *inermis* il porte des petits tubercules, et par les valvules de l'oviscapte qui dépassent bien l'opercule, tandis que dans *inermis* elles n'atteignent pas le bout de l'opercule.

Fam. ACRIDIIDAE.

Sous-fam. *TETRIGINAE.*

Paratettix variabilis Bol.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 18, 1923, 1 ♀; idem, Chuuri, 1000–2000 ft. Jan. 24–25, 1923, 2 ♀♀.

Sous-fam. *TRUXALINAE.*

Aeolopus dubia Will.

Localité : New Hebrides, Espir.-Santo Isl. (Shark Bay, clearings), Jan. 22, 1923, 1 ♀; Efate Isl., Dec. 1922, 1 ♀; idem (Vila, clearings), Dec. 18, 1922, 1 ♂.

Sous-fam. *OEDIPODINAE.*

Heteropternis obscurella Blanch.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 2, 1923, 1 ♀.

Sous-fam. *CYRTACANTHACRINAE.*

Oxya gavisa Walk.

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 9, 1923, 3 ♂♂, 1 ♀; idem (open forest), 2 ♀♀; idem, Chuuri, 1000–2000 ft., Jan. 25, 1923, 2 ♀♀.

Austracris guttulosa Walk., subsp. *illepida* Walk.

Localité : New Hebrides, Efate Isl. (Vila, clearings), Dec. 21, 1922, 1 ♂; Espir.-Santo Isl. (open forest near Hog Harbour), Jan. 8, 1923, 1 ♂; idem (Hog Harbour, clearings), Jan. 19, 1923, 2 ♂♂; idem (Shark Bay, clearings), Jan. 22, 1923, 1 ♂; Banks Isl., 2 ♀♀.

Hebridea nov. gen.

Corps étroit, allongé, ponctué rugueusement. Fastig. vertic. avancé horizontalement en avant des yeux, le bord antérieur arrondi, le bord latéral sub-parallel, avec une petite carène médiane. Le front fortement déclive, la carène frontale à peine indiquée, ainsi

que les carènes latérales. Les yeux ovales, assez saillants. Les antennes plus longues que la tête et le pronotum, réunies, filiformes.

Pronotum presque cylindrique, un peu élargi postérieurement, rugueux, le bord antérieur et postérieur arrondi, carènes médiane et latérales nulles, avec une faible indication de sillons transversaux, le sillon typique situé bien loin après le milieu.

Le bord inférieur du lobe réfléchi subanguleux, angle antérieur subaigu, angle postérieur arrondi.

Les organes du vol plus ou moins rudimentaires, abrégés.

L'élytre atteignant le bout du 3e segment abdominal, acuminé à l'apex arrondi; la vénulation rudimentaire.

L'aile presque aussi longue que l'élytre, rudimentaire, de forme normale.

Le tubercule prosternal en forme de lame transversale, comprimé d'avant en arrière, l'apex tronqué, avec un petit tubercule obtus aux coins.

L'espace mésosternal étroit, en forme de X, le bord intérieur du lobe mésosternal arrondi.

Les lobes métasternaux se réunissent au milieu sur toute la longueur.

Le fémur postérieur avec toutes les carènes lisses.

Le lobe géniculaire interne et externe se terminant en pointe obtuse. Le tibia postérieur au bord interne (l'épine apicale y comprise) avec 9 épines, le bord externe avec 9 épines, pourvu d'une épine apicale.

Le tarse postérieur long, presque aussi long que la moitié du tibia postérieur.

Le 3e article du tarse postérieur presque aussi long que les deux autres réunis.

♂. Plaque suranale triangulaire, l'apex pointu, avec un sillon longitudinal médian.

Cerque court, droit, ne dépassant pas le bout de la plaque suranale, acuminé.

Plaque sous-génitale recourbée, arrondie au sommet.

Ce genre vient se placer près de *Peitharchicus* Brunner, dont il diffère par les tibias postérieurs de forme non arrondie et de *Leptacris* Walk. par le nombre d'épines des tibias postérieurs, étant 9 chez *Hebridea* et 20–21 chez *Leptacris* Walk.

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NEW HEBRIDEAN ORTHOPTERA.

Hebridea rufo-tibialis nov. sp.

Génotype.—Couleur du corps brun-olive. Antennes rouge-brunâtres, les articles du milieu plus foncés.

L'élytre verdâtre. Le fémur postérieur vert-olive, les genoux rembrunis. Le tibia postérieur, ainsi que le tarse, d'un beau rouge. Les épines rouges, à l'apex noires.

Fig. 5.—*Hebridea rufo-tibialis* nov. gen. et spec. ♂.

	♂.
Longueur du corps	20 mm.
„ de l'antenne	9 „
„ du pronotum	4 „
„ de l'élytre	6·5 „
„ du fémur postérieur . . .	10 „
„ du tibia postérieur . . .	9 „
„ du tarse postérieur . . .	4 „

Localité : New Hebrides, Espir.-Santo Isl. (Hog Harbour, clearings), Jan. 4, 1923, 1 ♂, type. Text-fig. 5.

Description of Plate LI.

Fig. 1. *Euconocephalus extensor* Walk.
2. *Salomona magnifica* n. sp.
3. *Gryllacris poultoni* n. sp.
4. „ *punctipennis* Walk.

Photographs by C. Willemse.

XXII. *The Venation of the* Hepialidae.

By Alfred Philpott, Hon. Research Student in Lepidoptera, Cawthron Institute, Nelson.

[Read November 18th, 1925.]

Plates LII, LIII.

In dealing with the venation of the Hepialidae it is not necessary to consider the fore-wings and hind-wings separately, except in the case of the second cubitus and the anal veins. The descriptions and observations may therefore be understood to apply to both wings unless it is expressly stated to the contrary.

The Humeral Veinlet (hm).

The chief feature in the venation of the Hepialidae is the strongly developed humeral veinlet in both fore-wings and hind-wings. Usually, the presence of this veinlet in the Lepidoptera is correlated with a strong arching of the costa basally (*cf.* the hind-wings of the Rhopalocera and the Lasiocampidae). In the Hepialidae the arching of the wings in the humeral area is very slight. The subcostal vein is, however, remote from the costal margin, and thus the humeral veinlet serves to strengthen an otherwise unsupported area. In nearly all cases the humeral veinlet reaches and fuses with the costal vein, as represented by the costal margin, but in a few instances, as noted below, the costal vein, for a short distance before and beyond where the humeral veinlet joins it, is free of the margin. In *Oncopera*, and less noticeably in some species of *Hectomanes*, the humeral veinlet does not quite reach the costa. This non-fusing of the veins may be regarded as the result of reduction, and in the case of *Oncopera*, in which the condition is most marked, it may be noted that, on other venational grounds, the genus is one of the most specialised in the family. It may be advisable to mention here that the writer does not regard the instances of humeral veinlets occurring in certain groups of the Heteroneura as homologues of the veinlet in the Homoneura, but rather as secondary structures brought about by the need for strengthening an amplified wing area.

The Costal Vein (C).

In *Charagia* a portion of the costal vein is to be seen completely, though not widely, separated from the costal margin. The humeral veinlet fuses with this free portion, which maintains the free state from a little distad of the fusion to above the first radial fork (rf). A similar, though less clear, condition occurs in *Trictena*, but none of the other genera appear to have C separate at all from the costal edge.

The Subcostal Vein (Sc).

In several of the genera the subcosta and the radius seem, at first sight, to fuse at about the point where the humeral veinlet arises, but in reality the subcosta passes beneath the radius in such a manner as to be almost, frequently completely, hidden. Close examination will show the strong basal parts of each vein lying practically opposite each other on separate sides of the wing. The subcosta is in all cases a simple vein, there being no apical forking.

The Radius (R).

The radius is a strongly developed vein, the basal portion being particularly robust. R1 separates from Rs at a point usually not far distad of hm. Its apical half lies very close to Sc, and when viewed from beneath it is sometimes difficult, owing to the alternate convexity and concavity of the wing, to determine whether these veins are separate or fused. In no case, however, is there any real coalescence.

The four branches of the radial sector are always present, but there is a good deal of variation in their arrangement. The second dichotomic forking (rf′) is usually moderately near the apex of the cell, but in *Trictena* it is situated, in both wings, slightly basad of the middle. R2 and R3 are always stalked, the forking usually occurring more than halfway from the point of origin. In *Porina* R4 rises, in both wings, from the stalk of R2 + R3, while in *Perissectis* R1 is also fused with the same stalk. Usually, R4 and R5 are free, but in *Oncopera* these veins are closely approximated at origin in the hind-wing and shortly stalked in the fore-wing. In *Hectomanes* the stalking is of greater extent and is equally developed in both wings.

The Media (M).

The media has always three complete branches, M1, M2 and M3, except in the hind-wing of *Perissectis*, where M2 is missing. The basal portion of M4, before it fuses with Cu1a, is outwardly oblique, that is, it retains the original direction of the branch. The media rises close beneath the radius, being in some instances for a short distance fused with it. At or near the base of the humeral veinlet it bends abruptly downwards and soon divides, the lower branch (M5) forming the upper fork of the cubital Y-vein. The upper branch, which is extremely feeble, and sometimes obsolete, curves upward into the cell where it shortly forks (mf′) into the stalks M1 + 2 and M3 + 4. These basal details are seldom all clearly present, especially in the hind-wing.

The Cubitus (Cu).

In the fore-wing the basal part of the cubitus is weakly developed as far as the cubital fork (cuf). Beyond cuf the second cubitus fades out almost immediately; the first cubitus, however, strengthens on bending sharply upwards to join M5 and terminates in two normally strong branches. The cubito-anal cross-vein (cu-a) usually rises just basad of cuf, but it may be much nearer the base, as in *Porina*. In *Oncopera* Cu2, soon after branching from Cu1, is angled sharply downwards and connects with the analis, thus forming a small cell. The portion closing this cell distally has all the appearance of being originally a second cubito-anal cross-vein, the terminal portion of Cu2 having become obsolete. In *Phassus* (*P. malabaricus*) a similar structure appears, and in this case Cu2 still persists as a short projection beyond the small cell. In *Perissectis* the first cubitus takes part in the formation of a small cell by fusing with the stalk of M3 + 4 to a point considerably beyond mf′.

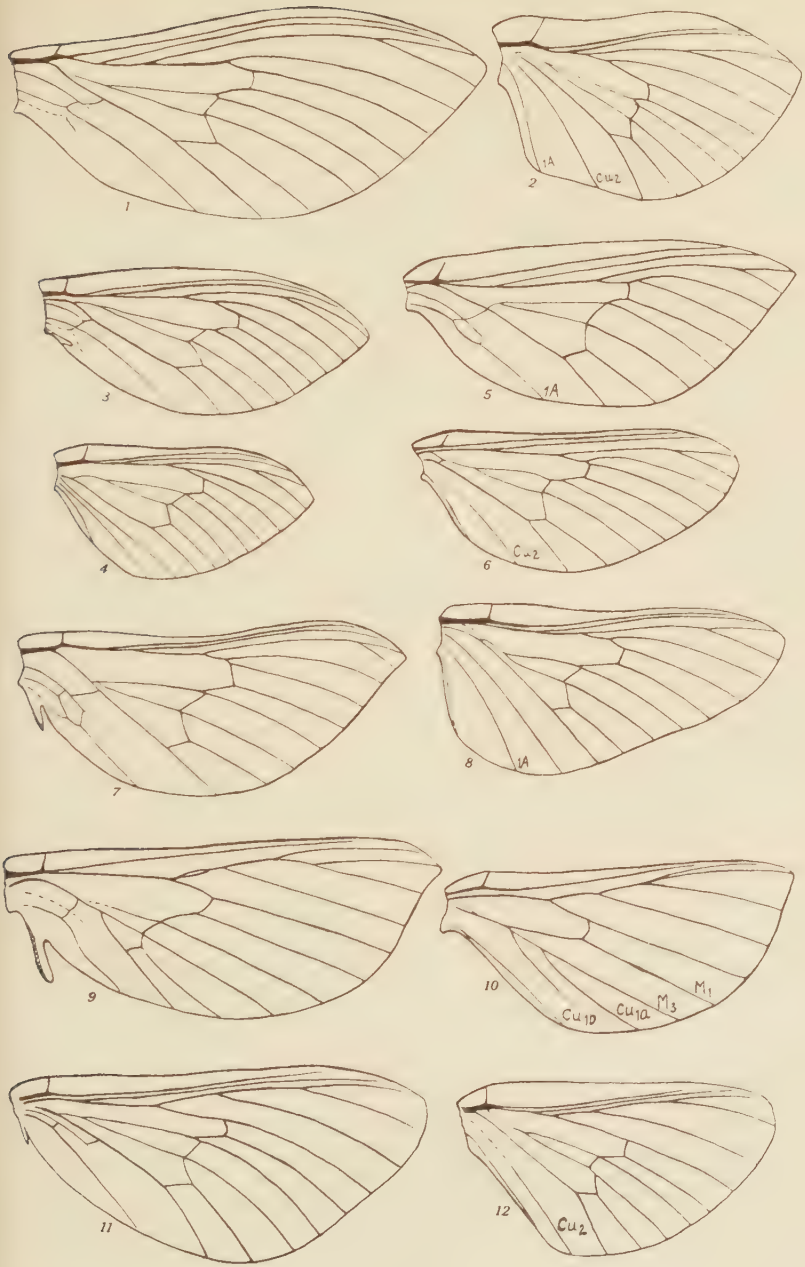
In the hind-wing the cubito-median Y-vein is not usually present, but *Leto*, in several other respects also one of the most primitive of the Hepialidae, has retained this formation.

In the area lying between Cu1 and the dorsum there are either two or three veins. Of these I regard in all cases the upper one as the second cubitus, being led to such conclusion chiefly by the concave nature of this vein; the basal connections are generally ill-defined and uncertain.

The Analis (A).

In the fore-wing 1A is always present and in some genera, as *Trictena*, *Pielus*, *Phassus* and *Leto*, 2A exists as a weak basal piece which soon curves up and fuses with 1A. Sometimes the remains of a trachea can be seen distad of the fusion, indicating the original course of the second analis. *Hectomanes* has the second analis more strongly marked. It is stated by Comstock ("Introduction to Entomology," p. 61), and has been repeated by other writers, that a branch of the third analis (second analis of this paper) passes down the jugum. I have not been able to find any trace of such a vein in any species examined by me, and I am the more inclined to think it an error, as, through the kindness of Mr. Keppel H. Barnard, of the South African Museum, I have been able to examine a species of *Prototheora* in which 3A, though present, does not pass down the jugum but pursues a course just above its base.

In the hind-wing two anal veins are present in *Leto*, *Pielus*, *Phassus* and *Charagia*; these I take to be 1A and 2A. All the other genera which I have been able to examine have only one analis. It is difficult to pronounce with certainty whether this single vein represents 1A or 2A, but from its position close to the margin of the dorsum, which agrees with that of 2A in those instances where both veins are present, I incline to regard it as the second analis, the first having entirely disappeared. This view gains in probability when it is observed that in *Sthenopis* this single vein is basally forked, and that the upper portion of the fork is very weak, representing almost certainly the remains of the vanishing first analis.



A. P. del.

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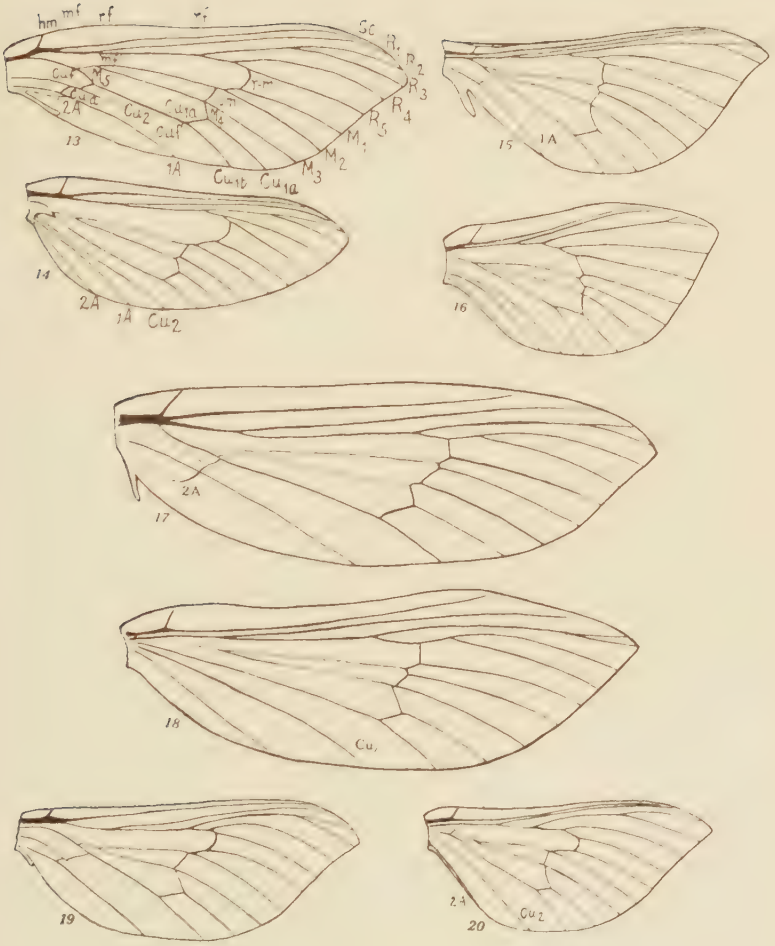
VENATION OF HEPIALIDAE.



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VENATION OF HEPIALIDAE.

Explanation of Plates LII, LIII.

(Full lettering of the veins is given in Fig. 13, but in the other figures only such details are lettered as those to which it is desired to draw attention.)

PLATE LII.

Fig. 1. *Trictena labyrinthica* Don. Fore-wing.
2. *Trictena labyrinthica* Don. Hind-wing.
3. *Pielus hyalinatus* H.-S. Fore-wing.
4. *Pielus hyalinatus* H.-S. Hind-wing.
5. *Oncopera mitocera* Turn. Fore-wing.
6. *Oncopera mitocera* Turn. Hind-wing.
7. *Phassus malabaricus* Mo. Fore-wing.
8. *Phassus malabaricus* Mo. Hind-wing.
9. *Perissectis australasiae* Don. Fore-wing.
10. *Perissectis australasiae* Don. Hind-wing.
11. *Porina despecta* Walk. Fore-wing.
12. *Porina despecta* Walk. Hind-wing.

PLATE LIII.

Fig. 13. *Leto stacyi* Scott. Fore-wing.
14. *Leto stacyi* Scott. Hind-wing.
15. *Charagia lignivora* Lw. Fore-wing.
16. *Charagia lignivora* Lw. Hind-wing.
17. *Hectomanes simulans* Walk. Fore-wing.
18. *Hectomanes simulans* Walk. Hind-wing.
19. *Sthenopis argenteomaculatus* Harr. Fore-wing.
20. *Sthenopis argenteomaculatus* Harr. Hind-wing.

XXIII. *Diptera (excluding Nematocera) from the Island of Rodriguez.*

By Prof. Mario Bezzi (Turin) and C. G. Lamb, M.A., Sc.D. (Cantab.), B.Sc. (London), F.E.S.

[Read November 18th, 1925.]

With Twenty Text-figures.

PREFACE

This paper contains an account of all the Diptera, other than Nematocera, in the collection of insects made in Rodriguez from August to November, 1918, by Messrs. H. P. Thomasset and H. J. Snell, and brought to the University Museum of Zoology, Cambridge, in 1919. Certain groups were sent for study to the first,* while others were worked out by the second, of the two authors named above. The separate sections of the paper for which the two writers are responsible are distinguished by the names or initials of the writers. The combining of their contributions into a single paper has been the work of the second-named author. Professor Bezzi's manuscript was received more than four years ago, but unfortunately circumstances have delayed completion of the work. In the meantime the material of the genus *Atherigona* has been examined by Mr. J. R. Malloch, whose results have been published,† and are taken into account in the following pages.

The Nematocera contained in the collection of Messrs. Thomasset and Snell have been worked out, and a paper on them was published by F. W. Edwards, Ann. Mag. Nat. Hist. (9), xii, pp. 330–337, 1923. Prefixed to Edwards' article was an Introductory Note by Hugh Scott, which included references to all papers on the Thomasset and Snell Collection which had previously appeared. For the sake of completeness it may be added that the following have since been published :—

Micro-Lepidoptera, by E. Meyrick, Trans. Ent. Soc. London, 1923, pp. 544–557, April 1924.

* In many cases only a few examples of a species were sent to Prof. Bezzi; the numbers of specimens given in the text are the total numbers in the collection, and have been inserted by Dr. Lamb.

† Ann. Mag. Nat. Hist. (9), xii, pp. 177–194.

[Coleoptera] Anthribidae, by K. Jordan, Novitates Zoologicae, xxxi, pp. 227–230, Oct. 1924.

Hemiptera-Heteroptera and Cicadidae, by W. E. China, Ann. Mag. Nat. Hist. (9), xiv, pp. 427–453, Oct. 1924, and *op. cit.* (9), xv, pp. 163–165, Jan. 1925.

Fulgorid Homoptera, by F. Muir, Trans. Ent. Soc. London, 1924, pp. 463–474, pl. xlvi xlvii, Feb. 1925.

The Types of the new species described below will be placed in the British Museum, and a set of the material will be kept in the Cambridge University Museum.

INTRODUCTORY REMARKS: By M. BEZZI.

Very few Diptera have been recorded from the island of Rodriguez. In the literature I have found only two notices about them: the first by Bigot, who in his "Diptères de Madagascar" (Bull. Soc. ent. France, (3), 7, 1859, pp. 546–547) reports the new genus and species *Elassogaster metallicus* from "Iles Roderigues—Collection de M. Guérin-Méneville"; the second by Frederick Smith, who in the zoology of the island worked out the Hymenoptera, Diptera and Neuroptera (Ann. Mag. Nat. Hist., (4), xvii, 1876, pp. 446 451, and Phil. Trans. Royal Soc., clxviii, extra vol., p. 538, 1879). He says: "Six species of Diptera were obtained, two belonging to the Tipulidae: these latter were in a fragmentary condition, and could neither be identified nor described: of the remaining four one is a described species, the others being apparently new."

Thus there were in all 5 species of Diptera recorded from Rodriguez, 1 Tabanid, 1 Ortalid, 1 Sapromyzid, 1 Calliphorid and 1 Sarcophagid. Seventy-nine species, representing 22 families, are enumerated in the present paper. Fourteen of these are described as new, and one new genus is proposed. If to these 79 species are added the 14 forms of Nematocera (or 16, if certain specimens in a state unfit for description are included) listed by Edwards (*l.c.*), the total number of Diptera known from Rodriguez amounts to 93 (or 95) species, representative of 27 families. This great increase in our knowledge of the Dipterous fauna of the island is due almost entirely to the diligence of Messrs. Thomasset and Snell; only a single species included in the following pages is not based either on the results of their

collecting or on the few earlier discoveries, namely *Oestrus ovis*, which finds a place here on the strength of an old specimen in the Cambridge Museum.

Stratiomyidae.

1. *Odontomyia* (*Eulalia*) *nigrinervis*, n. sp.

A species of usual form, closely allied to *limbifacies* Bigot (1859), from Madagascar, with the same type of face and with the same neuration of the wings, but at once distinguished by the thick veins of the wings being black, and by the almost entirely black abdomen.

7 ♂ and 7 ♀.

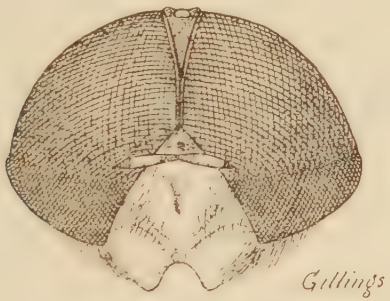


Fig. 1.—*Odontomyia nigrinervis* n. sp., ♂, head.

♂♀. Length of body 8 mm.; of wing 7 mm. *Head* with eyes bare, in the male touching for a long distance above the antennae, with the upper facets enlarged and sharply separated from the lower ones; in the female the eyes are widely separated, with the facets all equally small; in both sexes there are no traces of coloured bands in the dry condition. Occiput entirely black. Frons of male very narrow and pointed in front, shining black, with short dark hairs near the vertex. Frons of female very broad, as broad as one eye, gently convex above, with parallel sides; shining black, with very short darkish hairs at the vertex; towards the middle there is a broad transverse band of golden tomentum; in front there are 2 transverse ovate protuberances, separated by a deep furrow, reddish in their anterior part; between these protuberances and

those of the sides of the face there is a narrow transverse band of golden tomentum. Face of male rather narrow, triangular, carinate, reddish-yellow, black on the sides below, clothed (except on the middle above) with short silvery hairs. Face of female very broad, gradually widened below, bluntly carinate, shining reddish-yellow with 2 blackish spots on each side below; there are, moreover, 2 parallel transverse bands of golden tomentum, more distinct on the sides. Antennae dark reddish, third joint blackish at the end, but with the thick terminal style reddish. Peristome reddish, black near the eyes, with white or yellowish hairs; proboscis black. *Thorax* entirely shining black, clothed with erect greyish hairs; in the male there is sparse golden tomentum on the sides and in front, the sides and the pleurae being clothed with rather dense pale yellowish or whitish hairs; in the female the golden tomentum is denser and more developed, being present even in

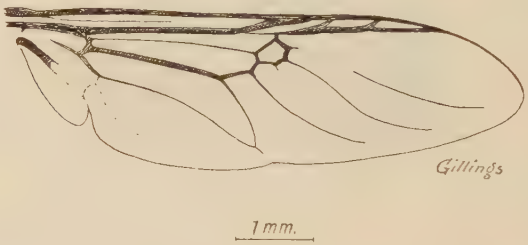


Fig. 2.—*Odontomyia nigrinervis* n. sp., ♂, wing.

front of the scutellum, and being very abundant on the pleurae, which are shortly pilose. Scutellum black, with a narrow yellowish hind border; spines yellowish, with a narrow black tip; at the hind border there are rather long yellowish hairs. Squamae blackish, with yellowish hairs on the border; halteres with green knob. *Abdomen* shining black and nearly bare, with only short yellowish hairs at the sides, more developed in the male; all the segments have at the sides a narrow, complete, even, green margination, which is extended more narrowly round the hind border of the last segment. Venter entirely green, with short white tomentum in the male, less distinct in the female. *Legs* entirely reddish-yellow, unspotted; coxae black; terminal segments of tarsi of last pair blackish. *Wings* hyaline, iridescent; the thick veins of the fore half blackish, except the costa near the base; end of 2nd costal cell and stigma infuscate, forming thus a blackish stripe along the middle of the fore border. Discoidal cell small, hexagonal, with the 2 upper sides longer than the 4 lower sides, which are all of

equal length; all the 3 veins issuing from the discoidal cell are not prolonged to the hind border, but only the second is complete, the first being hardly distinguishable at the base, and the third being indicated only by a very short stump (see Bigot, 1859, pl. iii, fig. 3). —M. B.

2. *Chrysocoma flavipennis* Macquart 1838.

4 ♂ and 5 ♀. Described from Madagascar.

The single specimen examined by me agrees perfectly with another specimen from Vohémar, Madagascar, in my collection. The antennae are not shaped as in *Ptecticus*, a genus in which the species was erroneously placed by Loew and by Bigot, and in which it is left in the various catalogues.

This Mascarene species is not far apart from the European *bipunctatus*; in the allied *flavomarginatus* Loew, from Mauritius, the thorax is yellow on the sides only, while in the present species it is quite yellow, with only faint metallic reflections on the back. From *lateritius* Rondani (assuming that this species should not really be placed in *Ptecticus*), it differs in the entirely black hind tarsi.

The insect is yellow, with white frons and white face; the vertical triangle, the sides of the occiput, the middle of the last abdominal tergites, the base of the hind tibiae and the hind tarsi, are black. The wings are hyaline, with a very faint yellowish tint.—M. B.

3. *Cephalochrysa hovas* Bigot.

One ♂ and one ♀ of this Madagascar species, which is also known from the Seychelles.—C. G. L.

Tabanidae.

4. *Bouvierella interrupta* n. sp.

Of the species tabulated by Surcouf ("Insectes piqueurs de Madagascar," 1909, pp. 176-177), this insect seems to be allied only to *B. flava*, but it is at once distinguished by the much darker coloration of the body and legs. All the remaining species of this genus (which is endemic to Madagascar, the Seychelles, and the Mascarene Islands), including the recently described *B. inornata* Austen,* from the Seychelles, have a complete fourth vein.

A unique example (♂).

* Bull. Ent. Research, xi, p. 44, 1920.

♂. Length of body 12 mm.; of wing 10 mm. *Head* black, but densely grey dusted. Eyes bare, unicolorous (dry), touching for a distance twice as long as the frontal triangle, with the upper anterior facets a little enlarged but not sharply separated from the others. Antennae with the 2 basal joints reddish, clothed with short dark hairs; third segment quite black. Hairs of the occipital border pale yellowish. Frontal triangle convex, rather prominent, bare. Face a little concave, with short but dense whitish hairs on the sides; beard longer, whitish. Palpi long, filiform, curved upwards, reddish, narrowly black at tip, clothed with very short hairs. Proboscis twice as long as the palpi; black with reddish base. *Thorax* and scutellum

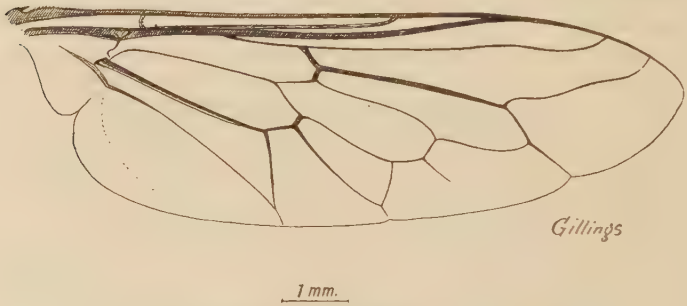


Fig. 3.—*Bouvierella interrupta* n. sp., ♂, wing.

entirely black, but densely grey dusted; on the back of the mesonotum there are 4 less distinct, darker, longitudinal stripes; the long erect hairs are blackish, but between them there are some other hairs, shorter and whitish; pleurae with dense tufts of soft, whitish hairs. Squamae dirty pellucid, with whitish border; halteres yellowish. *Abdomen* red, with the hind border of each segment paler and narrowly whitish; first segment broadly black in the middle; 2nd, 3rd, 4th and 5th with a rounded black middle spot, these spots decreasing in size backwards; 6th segment entirely black. Genitalia black, with reddish lateral lamellae. Venter quite reddish, unspotted, the segments with pale yellowish hind borders. On the tergites the hairs are dark in the middle, whitish at hind border of each segment and pale yellowish on the sides. *Legs* reddish, with black coxae and black tarsi; the front femora are broadly, the others only a little, blackened, tibiae with blackish tips; hairs are whitish on coxae, pale yellowish on femora, blackish on tibiae and tarsi. Claws black; pulvilli dirty yellowish. *Wings* greyish hyaline; veins yellowish at base, blackened at end. No

distinct stigma. The stump of vein between the 2nd and 3rd posterior cells is a little shorter than the stalk of the 1st posterior cell; the terminal stalk of the 4th posterior cell is as long as that of the anal cell. The discal cross-vein is placed very near the base of the discoidal cell.—M. B.

5. *Tabanus sequens* Walker (?).

Recorded by F. Smith under the above name; but there are 2 species described by Walker under this name, one in 1848 from Australia, and one in 1850 without record of locality. This latter can be regarded as the present species, as has already been done by Surcouf in his "Monograph of African Tabanidae," p. 251. If really a distinct species, it must be renamed. In the collection before me it is not represented.—M. B.

Bombyliidae.

6. *Geron umbripennis* n. sp.

This species is closely allied with the widely spread *G. hybridus* Meigen, which was found in Aldabra,* but it is distinguished by the black-haired basal segments of the antennae and by the infuscated wings. It recalls *G. priapeus* Bezzi, from the Cape Verde Islands, but is distinguished by the darker wings and by the less developed male genitalia.

11 ♂ and 9 ♀.

♂♀. Length of body 2·5–3 mm.; of wing 3·5–4 mm. The entire insect is of a deep black colour, clothed with pale yellowish hairs and with golden tomentum, the latter being more abundant in the female. *Head:* eyes bare, those of the male touching for a long distance, those of the female broadly separated; the upper facets are a little enlarged in the male. Vertex and occipital border with scattered bristly hairs. Frons of female with parallel sides, narrower than one eye, densely clothed with golden tomentum. Face neither produced nor prominent, clothed with rather short white hairs, and with the sides white pollinose; peristome with short hairs. Antennae quite black, the basal segments with short black hairs. Proboscis black, as long as head and thorax together. *Thorax* and scutellum with scattered, erect, dark hairs and with golden tomentum, more developed in the female; pleurae dark grey dusted, clothed with longer hairs. Squamulae whitish, with darker border,

* "Parasitology" (Cambridge), xv, p. 77, 1923.

and margined with whitish hairs; halteres yellowish. *Abdomen* coloured and clothed like the thorax, in the female greyer and with more abundant golden tomentum. Male genitalia of smaller size, with 4 shining black points. *Legs* entirely black, clothed with a pale, scaly tomentum and with black spicules. *Wings* iridescent, with a faint but distinct darkish tint; veins yellowish on the basal half, blackish on the rest. 2nd submarginal cell 1½ times as long as its breadth at the end; 1st posterior cell gradually widened outwardly, a little less than half as broad as the 2nd at the end; anal cell with a rather long stalk.—M. B.

7. *Villa sexfasciata* Wiedemann 1821.

6 ♂ and 5 ♀. One of the ♂ is only 6 mm. long, but the others are all about the same size as the ♀, namely 12 to 14 mm.

This is the same species as that recorded from Mauritius and from Aldabra and Assumption,* but it is probably different from the typical South African form.—M. B.

Therevidae.

8. *Psilocephala maritima* n. sp.

Closely allied to *brachycera* Loew, from South Africa and placed near that species in Kröber's monograph, but at once distinguished by the quite black antennae; in general appearance it is not very unlike the European *T. annulata*.

9 ♂ and 5 ♀.

♂♀. Length of body 7·5–8 mm.; of wing 5–6·5 mm. *Head* black, but densely clothed with white dust, which on the occiput in the male is a little bluish. Occiput above with black bristles, which are arranged in 3 irregular rows, and below with soft white hairs. Eyes bare and unicolorous; those of the male touching for a distance shorter than the frontal triangle, with the upper facets a little enlarged; in the female they are broadly separated, with equal facets. Ocellar triangle prominent, and clothed with black hairs. Frons of female not prominent, widening forwards, being three times broader near the antennae than at the vertex; it is destitute of shining callosities, and is velvety black on the two basal thirds, but in certain lights it appears lightly bronzed, only

* "Parasitology," xv, 1923, p. 77.

the anterior part then appearing black; the apical third, above the antennae, is white; the frons is bare, with some dark hairs only near the eyes. Frontal triangle of the male white, darkened near the eyes, with some scattered black hairs below. Face white, bare at the sides. Antennae entirely black and proportionally short; 1st segment not much thickened, grey-dusted, clothed with black hairs, as is the short 2nd segment; 3rd segment ovate-conical, a little shorter than the 1st, with a thick terminal style. Palpi thickened, cylindrical, black, white-haired; proboscis short and thick, black. *Thorax* black, but densely grey-dusted, bluish in the male, more yellowish in the female. There are on the back 3 broad longitudinal brown stripes, the middle one abbreviated behind and divided in front by a thin grey line. Pleurae more lightly dusted and clothed with whitish hairs, while the short hairs of the back are dark; bristles black, 3 on each side before the suture, 3 supra-alar and 2 pairs of well-developed *dc*. Scutellum like the back of the mesonotum, with white hairs at the hind border, and with 4 marginal black bristles. Pleurae without bristles; metapleural tufts dense and whitish. Squamulae with brown base, and the remainder whitish, with white hairs at the border; halteres blackish. *Abdomen* of male entirely covered with silvery-white dust, quite unspotted and clothed with soft white hairs; hind borders of the segments narrowly white; genitalia small, brownish. Abdomen of the female with the first segment grey; 2nd, 3rd and 4th segments black, even a little shining in the middle, with a whitish hind border, which is broadened at the sides; last segments entirely whitish, with a small black spot on the front border; vestiture of abdomen consisting of white hairs at the sides of the base and of black hairs on the remainder; the 3 terminal segments are clothed with peculiar, erect, thick, black hairs; spines of the ovipositor black. *Legs:* coxae and femora black, the latter with the knees narrowly yellowish; tibiae and tarsi yellowish, both with black tips; hairs of coxae and femora whitish, spicules and bristles black. *Wings* greyish-hyaline, iridescent along the hind border. Veins yellowish, darkened outwardly; pterostigma yellowish; the cross-veins in the middle of the wings, and those at the end of the discoidal cell, a little infuscated. Discal cross-vein placed a little before the middle of the discoidal cell; all the posterior cells are open, the 4th being only a little narrowed at the end; anal cell with a short stalk.—M. B.

Dolichopodidae.

The generic divisions given by Becker (Abh. Zool.-Bot. Ges. Wien, Band xiii, Heft 1, pp. 1–394, 1921) are adopted.

9. *Chrysosoma leucopogon* (Wied.).

1 ♂ and 4 ♀ of this wide-spread Oriental species. It may be noted that Bigot's *Psilopus noumeanus* from New Caledonia (Ann. Soc. Ent. France (6), x, p. 288, 1860) is this species. Specimens under that name are in Bigot's collection, now in the possession of Mr. J. E. Collin, and they are identical with the ♀ of this species.—C. G. L.

10. *Sciopus vagabundus* n. sp.

2 ♂ and 4 ♀.

There is a small S. American group of species (*dorsalis*

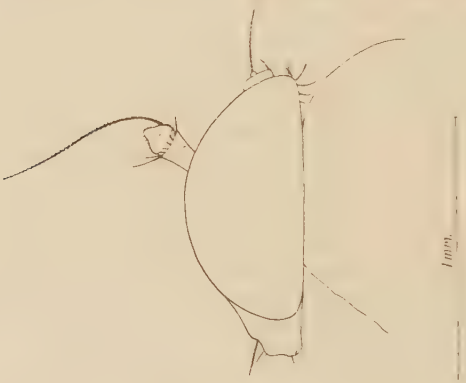


Fig. 4.—*Sciopus vagabundus* n. sp., ♂, head.

Loew; *striaticollis* Becker; and *flavidus* Aldrich, respectively described from Cuba, Brazil and Central America) which are characterised by the yellow thorax having a more or less well-defined middle stripe of metallic colour, the abdomen more or less annulated in yellow and metallic, and the costa very strikingly bristled in the male. The present species is undoubtedly a member of that group, and is nearest to *dorsalis*: the possibility of introduction should be borne in mind.

♂. *Head.* Frons shining violet with orange dusting, which is densest on the eye margins, but with a large oval area, which is quite bare, below each antenna. The long ocellars are inserted on a slight ocellar hump, but there are no other distinguishable

bristles: the last bristle of the short post-orbitals stands just on the outer edge of the vertical eye-margins, and may be looked on as a post-vertical. The face is brightly silvery and very narrow, the eyes almost touching in the middle. In side view the silvery labrum projects a little; the palpi are orange. The antennae are yellow with the 3rd segment slightly infuscate; it is of the usual small flattened triangular shape, with minutely pubescent arista.

Thoracic dorsum entirely shining orange, but an abbreviated stripe extending upwards from the scutellum is slightly greenish. The acrostichals are quite absent; 4 *dc*, the last or prescutellar pair being wider apart; scutellum rounded both horizontally and vertically, with a strong blue-green reflection showing through the orange: a single pair of long approximating scutellar bristles. The metanotum and pleura are entirely yellow. The *wings* are greyish with brown veins: the costa has a characteristic outstand-

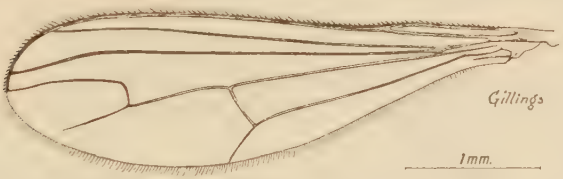


Fig. 5.—*Sciopus vagabundus* n. sp., ♂, wing.

ing bristled margin, and the hind margins are delicately haired. Squamal fringes long and pale. Halteres orange.

Legs entirely yellow, except that the tarsi are much darkened, being nearly black on the middle and hind legs, the tibiae of these legs getting more and more dusky from base to tip. The coxae are all yellow, the front ones being whitish yellow.

The bristles, etc., are as follows:—Front legs: femur and tibia about equal, the first tarsal segment about $1\frac{1}{3}$ times as long as the tibia, the 2nd and 3rd equal, and together about equal to the first. The only bristles are a few at the tip of the coxa, and a small inferior row on the femur; there is also a faint ciliation on the distal half of the first tarsal segment. Middle legs: Coxa with 2 or 3 bristles at the tip; tibia with a double row of inferior bristles, a large interior bristle at the base, and a small crown. Hind legs: very long, the femur being nearly as long as the abdomen, the tibia and tarsus about $\frac{2}{3}$rds as long; the tibia has two superior bristles on the basal third, and one at the beginning of the distal third.

The *abdomen* has all the segments with an orange ground-colour, with blackish bands across the internodes of the third and succeeding

segments, slightly increasing in width to the end of the abdomen. There is the usual fan of longish bristles just beneath the metanotum, sparse marginals and the usual general clothing bristles. The

Fig. 6.—*Sciopus vagabundus* n. sp., ♂, hypopygium.

hypopygium is small and little differentiated; it is all entirely orange.

♀. Face wider than in ♂, no outstanding costal pectination. Front femora with the usual "net" formed by 4 stout bristles on each coxa: no bristle rows on legs, but tibia of middle leg with about 4 superior-anterior bristles.

Length of body 4 mm.; of wing 3 mm.—C. G. L.

11. *Hydrophorus praecox* Lehm.

1 ♂ and 2 ♀ of this wide-spread species, noted as being found "on the surface of mud and pools at the river mouth."—C. G. L.

12. *Chrysotus seychellensis* Lamb, Trans. Linn. Soc. London, ser. 2, Zool., xviii, p. 400, Pl. 30, fig. 17, 1922.

1 ♂ and 21 ♀. This species was described from the Seychelles.—C. G. L.

Fig. 7.—*Sympycnus albipes* n. sp., ♂, wing.

13. *Sympycnus albipes* n. sp.

A pair of specimens of definitely Oriental type are present; they belong to the section in which the first two segments of the hind tarsus are shortened; and in which the front legs are also ornamented. Its nearest relative is *prospicuus* Becker.

♂. *Head:* the eyes touch below for a longish space, leaving a small silvery triangle below the antennae and a similar black one above the orange palpi; vertex depressed, brilliant blue-green, with long backwardly directed divergent ocellars on the hump, a single long vertical, and a small black post-vertical row. The antennae are entirely black, of the usual shape, with a long, shortly pubescent arista which has a slight bend at the joint between the flagellum and the next segment.

FIG. 9.—*Sympycnus albipes* n. sp., ♂, hind leg.

FIG. 8.—*Sympycnus albipes* n. sp., ♂, front leg.

The *thoracic dorsum* is bright shining green, with 5 *dc* (including prescutellars) and 2 or 3 longish single rowed acrostichals. The scutellum is rounded in outline, and somewhat flattened, orange with green central basal spot and a pair of long side bristles: pleura darkish orange, but the mesopleura slightly metallic-green.

The *wings* are as figured, glassy with blackish veins. Halteres orange.

Legs, including coxae, entirely yellow except where noted below.

Front legs: coxa with only a few hairs at tip, femur with slight upper row of bristles; tibia with 6 long hairs below; tarsus with

1st and 2nd segments of about the same length and a little dusky; 3rd, 4th and 5th flattened, in length together about equal to the 1st; 3rd segment blackened, 4th and 5th silvery.

Middle legs with no conspicuous bristles, there being only 2 or 3 of a superior row, and a small crown.

Hind legs: coxa with usual single bristle; femur flattened, with a small external apical bristle at the end; tibia with two bristles of a superior row on the mid third and a marked crown (inferiorly); tarsus with 1st and 2nd segments small and provided with tiny apical combs; the first has a few bristles, an inferior one being very

Fig. 10.—*Sympycnus albipes* n. sp., ♂, basal tarsal segments of hind leg.

evident, the second has a worm-like appendage; the 3rd and 4th segments are equal, the 5th is very small, and all have the usual tiny clothing bristles; the extreme tips of the tibia and first two tarsal segments are a little dusky.

The entire *abdomen* is almost black except for the 2nd segment which is dull orange; the tiny black appendages are just visible.

♀. Eyes separated as usual, but only by about $\frac{1}{8}$th of the single eye-breadth. Abdomen all blackish: bristles only on mid and hind femur.

Length of body just over 2 mm.; of wing the same.—C. G. L.

Pipunculidae.

14. *Pipunculus* (*Dorylas*) *crassus* n. sp.*

A small but robust species with dark pterostigma and shining abdomen, nearly allied to *brevicornis* Loew, from South Africa, but at once distinguishable by the acute third antennal segment.

Type ♂, type ♀, a single pair.

* If it is attempted to place this species by means of the key to the British species of *Pipunculus* given by Verrall ("Brit. Flies," vol. viii, 1901, p. 81), *P. crassus* falls into the section with coloured pterostigma and with no ciliation or pubescence behind the femora, that is, into what may be termed the *zonatus*-group, though its abdomen has a slight, dull shine, and is not so entirely opaque as in *zonatus* and some other species.—C. G. L.

♂♀. Length of body 3 mm.; of wing 4 mm. *Head:* eyes of male touching for a distance about as long as the narrow, white shining frontal triangle, with small facets; eyes of the female with the anterior facets very much enlarged. Vertical triangle

Fig. 11.—*Pipunculus crassus* n. sp., ♂.

shining black; occipital border grey dusted and bare. Face linear in both sexes, whitish dusted. Antennae black, with the 3rd segment very acute and pointed below, white dusted in the male, yellowish in the female. *Thorax* and scutellum black, quite bare, with a dark grey dust; on the back they are a little shining.

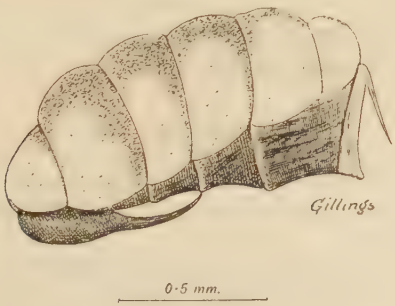


Fig. 12.—*Pipunculus crassus* n. sp., ♀, abdomen.

Squamulae whitish, bare; halteres pale yellowish. *Abdomen* slightly shining, black, each segment with a whitish-grey patch on either side. Male genitalia rather large, rounded, bare, shining black; female ovipositor acute, not much thickened at the base, the point extending to the middle of the venter. *Legs* with black coxae and black femora, the latter pale yellowish at the end; hind femora glistering

below; tibiae and tarsi pale yellowish, only the last tarsal segment being blackened above. Claws thin and long, longer in the female than in the male; they are pale yellowish, with narrow black tips; pulvilli pale yellowish. *Wings* greyish-hyaline, entirely iridescent, with a distinct but faint dark tint on the apical half. Veins thin and black; pterostigma brownish; small cross-vein placed in the basal third of the discoidal cell.—M. B.

Syrphidae.

For synonymy see Bezzi, "Syrphidae of the Ethiopian Region," published by the British Museum, 1915.

15. *Melanostoma annulipes* Macquart; Bezzi, *op. cit.*, p. 21.

14 ♂ and 20 ♀ of this African species, which is also found in the Seychelles.—C. G. L.

16. *Xanthogramma aegyptium* Wied.; Bezzi, *op. cit.*, p. 37.

5 ♂ and 3 ♀ of this Ethiopian species, also found in the Seychelles.—C. G. L.

17. *Xanthogramma pfeifferi* Bigot; Bezzi, *l.c.*

7 ♀ of this African and Mauritian insect.—C. G. L.

18. *Volucella obesa* Fabr.

2 ♂, 4 ♀. Also known from S. America, the Seychelles, and possibly Madeira and Mauritius.—C. G. L.

Phoridae.

19. *Dorhniphora cleghorni* (Bigot).

Phora cleghorni Bigot, Indian Museum Notes, i, no. 4, p. 191, 1890.
Phora chlorogastra Becker, Abh. Ges. Wien, i, p. 32, 1901.
Dohrniphora cleghorni Collin, Trans. Linn. Soc. London, ser. 2, Zool., xv, p. 106, pl. 5, fig. 1, 1912.

If the above synonymy is right, this species has a wide distribution over Mediterranean countries and the Ethiopian and Oriental Regions; Collin recorded it from the Seychelles. It is a domestic species, connected with man, and this explains the wideness of its range.

Two ♂.—M. B.

20. *Aphiochaeta xanthina* Speiser.

Aphiochaeta xanthina Speiser, Berlin. Ent. Zeitschr., lii, p. 148, 1908.

Aphiochaeta circumsetosa de Meijere, Tijdschr. v. Ent., liv, p. 348, 1911.

Aphiochaeta ferruginea Brunetti, Rec. Ind. Mus., vii, p. 84, 1912.

Aphiochaeta repicta Schmitz, Heerlen Natuurhist. gen. in Limburg Meded., 1914, p. 108 (1915); id., Wien. Ent. Zeit., xxxv, p. 228, 1916.

Another species found throughout the tropics and connected with man: it is at once distinguished from the preceding, apart from the generic characters, by the frons being reddish, not dull black, and by the hind tibiae being ciliated, not bare. It is recorded in medical literature, under the name *ferruginea*, as causing myiasis in man; and Grandi recorded it in 1914 (as *xanthina*) from orthopterous insects. I have compared specimens with cotypes of *ferruginea* from India in my collection.

If the North American *scalaris* Loew (1866) is the same species, as seems probable, this latter name has priority and must be used for the species.

Two ♀ from Rodriguez.—M. B.

Ortalidae.

21. *Chrysomyza tarsata* Macquart 1850; Hendel, Zool. Anz., xxxiv, 1909, p. 618.

One ♂.

The present species was described from Mauritius and recorded from South Africa by Hendel. It is not yet known from the Seychelles, from which are reported the 3 species *demandata* F., *azurea* Hendel, and *aenea* F.—M. B.

22. *Elassogaster metallicus* Bigot 1859; Hendel, Abhandl. Zool.-bot. Ges. Wien, viii, 1914, p. 81.

One ♂.

This endemic fly is the type species of the extensive genus *Elassogaster*; the present specimen answers very well to Bigot's description and figures, and to Hendel's Key.

The antennal arista is distinctly, though slightly, dilated at the end, but not in the shape of a spatula; the pubescence is very

short on the basal part. There is a strong genal bristle. The frontal band is quite dull. Antennae considerably shorter than the face. Upper mouth edge a little prominent; praelabrum broad, pale yellowish. Palpi yellowish, with white pubescence. Tibiae darkened, tarsi blackish, coxae yellowish like the femora. The wings are hyaline, but the front border is distinctly yellowish up to the third longitudinal vein, and the anterior cross-vein is distinctly margined with fuscous; the apex of the wing, between the ends of 2nd to 4th longitudinal veins, has a dark shade near the costa. The small cross-vein is placed at the middle of the discoidal cell; the fourth vein is strongly curved above near the end, the first posterior cell ending a little before the tip of wing; the second basal cell is one-third of the length of the discoidal cell; hind cross-vein placed in the middle between the small cross-vein and the bend of the fourth.—M. B.

Lonchaeidae.

23. *Lonchaea* (*Lamprolonchaea*) *aurea* Macquart 1851; Bezzi, Bull. ent. Res., ix, 1919, p. 246 and xi, 1920, p. 202.

11 ♂, 9 ♀.

This species is widely distributed in Mediterranean countries, and over the Ethiopian, Oriental and Australian Regions.—M. B.

24. *Lonchaea* (*Carpolonchaea*) *ophyroides* Bezzi, Bull. ent. Res., xi, 1920, p. 203.

4 ♂, 15 ♀.

These specimens agree very well with the typical ones from East Africa, recently described by me. It is a species of proportionately greater size.—M. B.

Trypaneidae.

25. *Spheniscomyia sexmaculata* (Macquart); Bezzi, Mem. Ind. Mus., iii, p. 148, Pl. 10, fig. 53, 1913.

Urophora sexmaculata Macq. 1843.
Trypeta atilia Walk. 1849.
Ortalis sanctae-mariae Bigot 1859.
Trypeta melaleuca Walk. 1864.
Trypeta sexincisa Thomson 1868.
Acidia melania Bezzi 1908.
Spheniscomyia formosana Enderlein 1911.

One ♀.

A well-known species, widely spread over the Ethiopian and Oriental Regions, from South Africa to the Philippines and Formosa. The type of *Ortalis sanctae-mariae* Bigot was described from a small island near Madagascar.—M. B.

26. *Oxyna sororcula* Wied.

Twenty-four specimens of this wide-spread species.—C. G. L.

27. *Rhabdochaeta speciosa* Lamb, Trans. Linn. Soc. London, ser. 2, Zool., xvi, p. 320, fig. 13, and Pl. 19, fig. 10, 1914.

One ♂. Described from the Seychelles.—C. G. L.

Sepsidae.

28. *Sepsis impunctata* Macquart.

Sepsis impunctata Macq. 1839.
Sepsis rufa Macq. 1850; Melander and Spuler, Wash. Agric. Exp. Station, Bull. 143, pp. 89, 90, 1917.

Both the paler form and the dark form occur; 3 ♂ and 1 ♀ of *rufa* and 6 ♀ of *impunctata*.

The species is Mediterranean, Ethiopian and Oriental, and is found in the Seychelles and New Guinea.—M. B.

Sapromyzidae.

29. *Sapromyza squalida* Smith, Ann. Mag. Nat. Hist. (4), xvii, p. 450, 1876; Phil. Trans. R. Soc. clxviii (extra vol.), p. 539, 1879.

Eleven specimens.

This endemic species is near *S. trinotata* Loew, described from S. Africa, Ofv. K. Vetensk. Ak., Stockholm, xix, 1862, p. 8.—C. G. L.

30. *Trigonometopus magnificus* n. sp.

A pretty species, very distinct by the peculiar coloration of the pleurae, and by the yellowish un-variegated wings.

Type, ♂, and 11 other specimens from Rodriguez. A single headless specimen from Mahé is in the Seychelles collection.

♂. Length of body 3 mm.; of wing 3 mm. In the present species the frons is not much produced forward, as is the case with

many other exotic species; the face is thus less retreating than in the typical forms of the genus, but the angle formed by the frons and the face is always a very acute one. *Head* entirely whitish, with a broad longitudinal brown middle stripe on the frons; this stripe crosses the ocellar tubercle and is prolonged behind on the middle of the occiput; this latter has also a brown rounded patch on each side; the frontal dark stripe has an elongate triangular shape, ending acutely just above the small whitish lunula; face and peristomialia quite unspotted. Antennae yellowish, with the third segment rounded at the end, nearly circular, blackish along its upper border; arista long, horizontally porrected, entirely black,

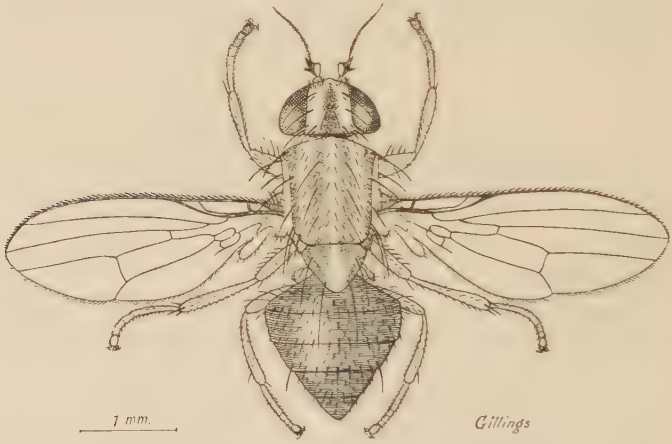


Fig. 13.—*Trigonometopus magnificus* n. sp.

rather thickened at the base, and microscopically pubescent. Eyes slightly oval and placed obliquely, their horizontal diameter being a little greater than the vertical one. The peristomial bristles are thin, black, 5–6 in each row. Palpi and proboscis pale yellowish. The cephalic bristles are black, post-verticals decussated; inner verticals longer and parallel; outer verticals shorter and directed outwardly; ocellars stronger than the post-verticals; 2 pairs of strong and long orbitals, placed on distal or anterior half of the frons, both curved backwards. There are black hairs on the anterior part of the frons, just above the antennae. *Thorax :* back of mesonotum reddish, whitish pruinose, with 4 equal, rather broad, complete, parallel, brown longitudinal stripes, the inner ones placed interiorly to the dorso-central bristles, the outer ones interiorly to the notopleural line and in contact with it. The pleurae are of

a bright yellow colour, extending as a broad stripe across the mesopleura; the sternopleura is reddish, marked on its upper external angle with a deep black rounded spot. Scutellum reddish-yellow, but with a broad brown stripe on each side, in continuation of those on the middle of the thorax. Mesophragma reddish-brown. Calypters white; halteres yellowish. All the bristles black, like the short hairs on the dorsum; dorso-centrals 2 + 1, long and strong, only a pair after the suture or praescutellars; one mesopleural; 2 sternopleural, the anterior one the shorter; mesopleura with some scattered hairs. Scutellum bare on the disc, with 4 strong marginal bristles, the apical ones longer and divergent. Abdomen reddish-brown on middle and at end; pale yellowish on sides and below; hair black. *Legs* including coxae entirely pale yellowish, unspotted, only the anterior tarsi being darkened. *Wings* yellowish-hyaline, quite unspotted, with pale yellowish veins; the anterior half is more intensively yellowish. Small cross-vein placed a little before the middle of the discoidal cell; hind cross-vein straight, perpendicular, about as long as the terminal portion of the fifth longitudinal vein. First longitudinal vein short; third vein ending exactly at the tip of the wing, divergent from the second at the end, but parallel with the fourth; sixth longitudinal vein represented only by a very short stump.—M. B.

Geomyzidae.

31. *Amygdalops thomasseti* Lamb, Trans. Linn. Soc. London, Ser. 2, Zool., xvi, p. 357, Pl. 21, figs. 48 and 50, 1914.

Two ♂. This genus was founded for the above Seychelles species, but two other species have been described from Java by de Meijere; Tijdschr. v. Ent. 59, pp. 207, 208, 1916.—C. G. L.

Chloropidae.

32. *Hippelates longiseta* Lamb, Trans. Linn. Soc. London, Ser. 2, Zool., xv, p. 334, Pl. 16, fig. 9, 1912.

3 ♂, 4 ♀. This Seychelles species also occurs in S. Africa, from whence specimens have been sent by Mr. F. Muir.—C. G. L.

33. *Hippelates bipustulatus* n. sp.

Allied to *nigricornis* Thomson, but distinguished by the black spot on the pleura; in this character it agrees with *minor* de Meijere, but has black antennae and no black

stripes on the back of the mesonotum; *H. stigmatica* Lamb (*op. cit.*, p. 334, 1912) has the black pleural spot, but has yellow antennae.

Type ♂, a single specimen submitted to Prof. Bezzi, and 6 other examples.

♂. Length of body 1·5 mm.; of wing 1·5 mm. *Head* entirely yellow, with a small black ocellar dot; eyes bare and rounded; antennae black, with a rounded third segment; arista black, bare; proboscis and palpi yellow; vertical bristles black. *Thorax* yellow, on the back almost entirely covered by 4 broad, dull reddish-brown,

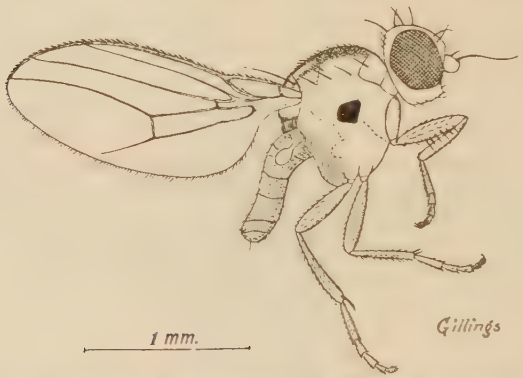


Fig. 14.—*Hippelates bipustulatus* n. sp.; the scutellum is purposely not shown through the base of the wing, as it would confuse the latter; part of the basal venation and the lateral thoracic sutures, not being quite clear, are indicated by dotted lines.

longitudinal stripes, of about equal breadth; pleurae more shining, the shining black circular spot being on the lower part of the mesopleura. Bristles of the sides black; no *dc*. Scutellum yellow, with black hairs on the disc, with 2 long apical bristles, and 2 shorter bristles on the sides. Halteres pale yellowish. *Abdomen* yellow, but apparently with a black stripe on each side. *Legs* entirely yellow. *Wings* hyaline, iridescent, with pale yellowish veins.—M. B.

34. *Gaurax insulicola* n. sp.

Somewhat different from the known species of the genus, and allied to the flies of the genus *Cestoplectus* Lamb (1918), which has, however, no orbital bristles.

Type ♂, submitted to me, and 2 other specimens.

♂. Length of body 1·8 mm.; of wing 1·8 mm. *Head* broader than the thorax, pale yellowish, with black, concave occiput. Frons flat, not prominent, gradually narrowed forwards, only ½ as broad near the antennae as at the vertex; dull yellowish, more reddish on the distal half, with whitish orbits; the frontal triangle is not well differentiated, being indicated only by a brownish, rather shining equilateral spot; vertical bristles yellowish; ocellar short; frons with short yellowish pubescence and with 5 long yellowish orbitals on each side, in addition the frontal triangle is margined with a row of bristly hairs on the sides. Eyes rounded and densely pubescent. Face concave and very short, only half

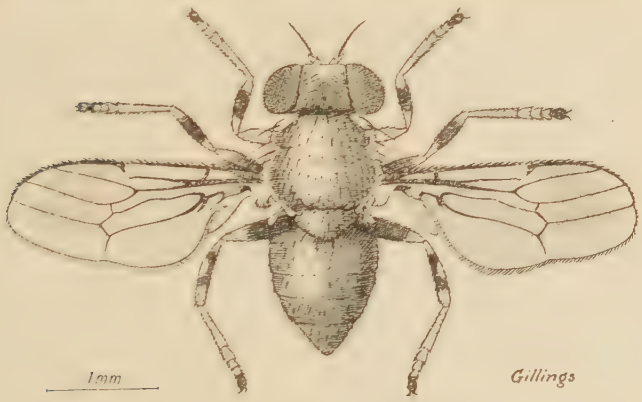


Fig. 15.—*Gaurax insulicola* n. sp.

as long as the frons, white shining, with 2 hairs on each side of the mouth. Antennae yellowish with small round third segment; arista dark, pubescent. Peristomialia white and very narrow. *Thorax* rather shining, brassy black, with thin yellowish pubescence and destitute of bristles; humeri and a broad stripe to the root of the wings reddish; pleurae shining black. Scutellum rounded, coloured like the dorsum of the mesonotum, with a pair of darkish bristles. Halteres whitish. *Abdomen* shining black, with sparse pale pubescence. *Legs* pale yellowish or whitish, the femora with broad blackish-brown rings, the posterior ones being almost entirely brown on the middle; tibiae with a blackish middle ring, which is broader on the hind pair; last segment of all the tarsi black. *Wings* whitish-hyaline, with a faint yellowish tint on the basal half; apical half with a broad, less definite, fuscous patch extending from the front border to the fourth longitudinal vein, the apex of the

wing being, however, broadly whitish hyaline. Veins thick and blackish; the terminal portions of 2nd, 3rd and 4th veins straight and perfectly parallel to each other; last portion of the 5th vein almost perpendicularly bent at the hind angle; hind cross-vein short, only a little longer than the anterior one and oblique. Terminal part of the first longitudinal vein thickened, and before it there is a distinct pale fold, which is correlated with the power of folding up the wing.—M. B.

35. *Formosina lucens* (de Meijere).

Chloropisca lucens de Meij. 1908.

5 ♂ and 6 ♀.

This specimen agrees perfectly with the original description of this Javanese fly and with the table in Becker's monograph; it is larger, measuring 3 mm. instead of 2; the basal part of the scutellum seems to be more broadly black.—M. B.

36. *Rhodesiella aeneifrons* (Lamb).

Described under de Meijere's generic name, *Meroscinis*, Trans. Linn. Soc. London, Ser. 2, Zool., xv, p. 332, Pl. 16, figs. 6, 7, 1912. (For reasons of change of generic name see Bezzi, Journ. New York Ent. Soc., xxvii, p. 174, 1919, and Lamb, Ann. Mag. Nat. Hist. (9), i, p. 333 (footnote), 1918.)

5 ♂ and 15 ♀ of this Seychelles species. There are also South African examples in the collection of S. African Diptera given to the Cambridge Museum by Mr. F. Muir.—C. G. L.

37. *Scoliophthalmus micans* Lamb, Ann. Mag. Nat. Hist. (9), i, p. 331, 1918.

2 ♂ and 2 ♀ of this S. Indian species.—C. G. L.

38. *Siphunculina intonsa* Lamb, *l.c.*, p. 345.

1 ♂. This species was described from Ceylon.—C. G. L.

39. *Oscinis ? formosa* Becker, Ann. Mus. nat. Hung., ix, 1911, p. 154 (*Oscinella*).

Two ♂.

The larger of these specimens, measuring 1·5 mm. in length, has the reddish thoracic stripes more developed, while the smaller one (1 mm.) shows these stripes distinctly

only in front of the mesonotum; both have a black ocellar dot at the base of the shining yellow frontal triangle. They agree fairly well with the description of the present species, the type of which is from Formosa, and are allied to *O. inornata* Becker and de Meijere (*Oscinella*), Tijdschr. voor Entom., lvi, 1913, p. 304, from Java, in which, however, the back of the mesonotum is said to be opaque, instead of shining as it is here.—M. B.

40. *Oscinis ? lucida* Becker and de Meijere, Tijdschr. voor Entom., lvi, 1913, p. 303 (*Oscinella*).

One headless ♀.

This agrees well enough with the description of this species from Java, and is distinguished from the preceding one by its greater size, the darker coloration of the body, especially of the abdomen, and by the darker wings and wing-veins. The second longitudinal vein is shorter, and the cross-veins are more approximated than in Becker's original description.

Note.—It is worthy of remark that the two species of *Oscinis* from Rodriguez are both entirely yellow, while those recorded from the Seychelles are all black or very dark. All the numerous Ethiopian species described by Becker (Ann. Mag. nat. Hung., viii, 1910 and xi, 1913) are likewise black, while in the Oriental Fauna the yellow forms are fairly numerous.—M. B.

Ephydridae.

41. *Scatella septemfenestrata* Lamb, Trans. Linn. Soc. London, xv, p. 328, fig. 17, 1912.

One ♀.

Closely allied to the European *stagnalis*, but with 2 additional spots on the wings. Described from the Seychelles.—M. B.

42. *Discocerina obscurella* Fallén 1813.

One ♀, agreeing perfectly with European specimens. No species of the present genus have been recorded from the Seychelles or from the Ethiopian Region.—M. B.

43. *Hecamede lacteipennis* Lamb, *l.c.*, p. 318, fig. 9, and Pl. 15, fig. 15.

One ♂.

Closely allied to the European *albicans*, but a little more

robust and with less setulose peristomialia. The frons is more broadly orange in front, but less than is stated in the original description of the species from the Seychelles.—M. B.

44. *Discomyza maculipennis* (Wiedemann).

Notiphila maculipennis Wiedemann 1824.
Homalura maculipennis Wiedemann 1830.
Discomyza amabilis Kertész 1901.
Discomyza maculipennis de Meijere, Tijdschr. v. Ent., xli, p. 166, 1908.

One ♂, agreeing perfectly with my specimens from Singapore and with those from the Philippines sent me by Prof. Baker. This is the first time that the present species, widely spread over the Oriental and Australian Regions, is recorded from the Mascarene Islands. It seems to be in some way connected with man, as it is frequently said to be found on windows. *Discomyza obscurata* Walker (1860) is probably this same species.—M. B.

Drosophilidae.

45. *Drosophila punctulata* Loew.

One specimen of this wide-spread tropical species.—C. G. L.

46. *Drosophila* sp.

A second species is present in the collection: it is an obscure insect, somewhat resembling the common *D. funebris*. As Dr. Duda is engaged on monographing the Drosophilidae, the specimens have been sent to him.—C. G. L.

47. *Chymomyza bicolor* Lamb, Trans. Linn. Soc. London, Ser. 2, Zool., xvi, p. 348, fig. 32, and Pl. 20, fig. 35, 1914; Sturtevant, Carnegie Inst. Washington, Publication 301, p. 61, 1921.

A pretty, very distinct species, at once recognisable by its wings.

Two ♀. Described from the Seychelles.—M. B.

48. *Zaprionus vittiger* Coquillet, Proc. U.S. Nat. Mus. xxiv, p. 31, 1902.

Four specimens of this African species, also known from the Seychelles (Lamb, *op. cit.*, p. 348).—C. G. L.

Borboridae.

Two widely distributed species of this family were collected.

49. *Limosina punctipennis* Wied.

Two specimens.—C. G. L.

50. *Limosina curvinervis* Stenh.

One specimen.—C. G. L.

Milichiidae.

51. *Desmometopa M-nigrum* Zetterstedt.

Agromyza M-nigrum Zett., Dipt. Scand., vii, p. 2743, 1848.

Twenty-six specimens of this wide-spread species.—C. G. L.

52. *Desmometopa inauratum* Lamb, Trans. Linn. Soc. London, Ser. 2, Zool., xvi, p. 363, fig. 43 and Pl. 21, fig. 56, 1914.

A single ♂. —C. G. L.

Agromyzidae.

53. *Melanagromyza similis* (Lamb).

Agromyza similis Lamb, Trans. Linn. Soc. London, ser. 2 Zool., xv, p. 346, fig. 32, 1912.

Described from the Seychelles, and very like the European *aeneirentris* Fallén (see Hendel, *Arch. Naturg.*, lxxxiv, p. 126, 1920); but it is distinguished (like the allied *candidipennis* Lamb, *op. cit.*, Pl. 16, fig. 21) in having very narrow parafrontalia, quite destitute of hairs and with the orbitals placed very close to the borders of the eyes. Seven specimens.

The present species must be compared with *Agromyza metallica* Thomson (1868, p. 609), from Mauritius, in the description of which nothing is said about the colour of the halteres; but as Thomson described it as being closely allied to his *tristella* (of which he wrote " halterum clavâ albidâ "), the halteres of *A. metallica* may be considered to be white.—M. B.

54. *Melanagromyza galactoptera* n. sp.

Closely allied with *candidipennis* Lamb (*op. cit.*), but distinguished by the cross-veins of the wings being more distant.

Type ♀, and another specimen.

♀. Length of body 1·5 mm.; of wing 2 mm. Entire fly black, including the halteres, but with white calypters and whitish wings. *Head* dull black, only the frontal triangle and the upper part of the narrow eye-margins shining. Face not carinate. Eyes bare, or with scattered microscopic hairs only. Antennae black, with small and rounded third segment; arista bare. Palpi black.

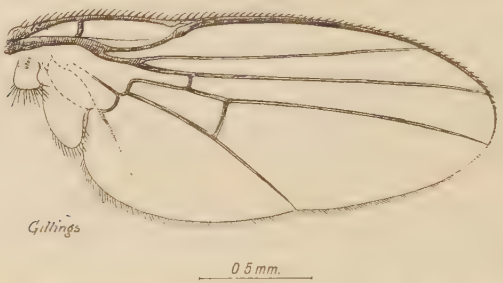


Fig. 16.—*Melanagromyza galactoptera* n. sp., ♀, wing; veins near the base, which could not be discerned clearly, are approximately indicated by dotted lines.

Chaetotaxy as in *candidipennis*, the narrow parafrontalia likewise bare. *Thorax* and scutellum shining black, with a faint greyish dust, destitute of greenish reflections; chaetotaxy as in *candidipennis*. Halteres black; calypters white and white fringed. *Abdomen* entirely black, more shining than the thorax, destitute of greenish reflections; clothed with short black hairs; last segment without longer hairs; ovipositor not distinguishable exteriorly. *Legs* quite black. *Wings* proportionally narrow and long; they are milky-whitish, with pale yellowish veins, only the apical half of the costa being black; the costa is well extended to the tip of the 4th longitudinal vein. The first 4 longitudinal veins are as in Lamb's fig. 31 (*op. cit.*, p. 346); the small cross-vein is placed just below the end of the 1st longitudinal vein; the hind cross-vein is perpendicular and its distance from the small one is about equal to its own length (not much shorter, as in *candidipennis*, in which, moreover, the hind cross-vein is oblique). The terminal segment of the 5th longitudinal vein is a little longer than the preceding segment (not much longer, as is the case in *candidipennis*).—M. B.

55. *Domomyza nigriclava* n. sp.

A true *Domomyza*, with the costa ending at the tip of the third longitudinal vein, but with black halteres, while all the other known species have white halteres.

Type ♂, and one other specimen.

♂. Length of body 1·4 mm.; of wing 1·6 mm. A quite shining black fly, with greyish-hyaline wings. *Head* entirely dull black, even the frontal triangle being very little shining. Antennae black, with the third segment small, rounded, with bare arista. Face not carinate. Palpi and proboscis black. Two pairs of *or.*; parafrontalia narrow and bare. *Thorax* and scutellum shining black, with no greenish reflections; 2 pairs of *dc*; *sa* very long; acrostichal setulae arranged in 8 longitudinal rows. Scutellum apparently with 4 bristles. Halteres with large, black, rounded knob; calypters dark. *Abdomen* shining black, with short black hairs; genitalia small. *Legs* quite black. *Wings* iridescent, with a faint but distinct fuscous tint. Veins black, only the anterior 3 being thickened, the others thin; costa ending at tip of 3rd vein; 5th vein thickened. The cross-veins are very close together, the posterior one being oblique inwardly and $2\frac{1}{2}$ times longer than the small one; their distance apart is as long as the lengths of the small cross-vein, or even shorter. The terminal portion of the 5th longitudinal vein is about as long as the preceding part, or only a little longer.—M. B.

Muscidae.

56. *Anthomyia illocata* Walker, 1856.

Anthomyia bisetosa Thomson 1868; Brunetti, Rec. Ind. Mus. i, 1907, p. 383, Pl. 15, fig. 4–5.

Anthomyia illocata Stein, Arch. Naturg. lxxxiii, A (1917), Heft 1, p. 147, 1919.

One ♀.

The present species is widely spread over the Oriental Region, and is distinguished from the Mascarene species *amoena* Macq. by the want of the black spots on the anterior part of the dorsum of the mesonotum.

The spurious prolongation of the last longitudinal vein is very faint and hardly visible, and thus the species may probably be congeneric with the following species.—M. B.

57. *Limnophora fasciolata* Stein 1910.

One ♀.

This species was described from the Seychelles. As the

third longitudinal vein bears no bristles near the base, the species cannot belong to the present genus as delimited by Malloch.—M. B.

58. *Limnophora* ? *desjardinsii* Macquart 1843.

One ♂, corresponding to Macquart's description of this species from Mauritius, which was left in the genus *Anthomyia* by Prof. Stein in 1919. There is no black transverse band anteriorly on the thorax; the third longitudinal vein has no bristles at the base. It is near *notabilis* and *simulans* Stein, with three dorsocentrals behind the suture.—M.B.

59. *Atherigona addita* Malloch, Ann. Mag. Nat. Hist. (9), xii, 1923, p. 189.

One ♂ was submitted to me: several ♂ and ♀ studied by Malloch.

Previously identified by me as *A. laeta* Wiedemann *sensu* Stein; but Malloch has recently shown that Stein's species was a mixture of several, and has described the present and the two following species as new. As far as at present known, they are endemic.—M. B.

60. *Atherigona grisea* Malloch, *op. cit.*, p. 190.

Two ♂, 1 ♀ were sent to me; there are a number of others, several of which were seen by Malloch. Previously identified by me as *A. humeralis* Wiedemann *sensu* Stein. —M. B.

61. *Atherigona minor* Malloch, *op. cit.*, p. 191.

One ♀ was seen by me, other examples by Malloch. Probably it is only a form of the preceding species, already separated, but not named, by me.—M. B.

62. *Fannia leucosticta* Meigen 1826.

Fannia brevis Rondani 1866.

One ♀, evidently belonging to the form recorded by Stein from the Seychelles, Trans. Linn. Soc. London, ser. 2, Zool., xiv, 1910, p. 155.

It is very like the Italian and North African specimens of *leucosticta* but, besides the character of the bristles of the hind tibiae already mentioned by Stein, it differs in the much more distinct dark stripes on the back of the mesonotum.—M. B.

63. *Ophyra chalcogaster* Wiedemann 1824; Malloch, Ann. Mag. Nat. Hist. (9), xi, 1923, pp. 664–666.

Several specimens of both sexes. A widely spread Oriental and Australian species, already recorded from the Seychelles and from Mauritius, but not yet found in continental Africa.—M. B.

64. *Stomoxys glauca* Grünberg 1906.

One ♂. This species has been recorded by Stein from the Seychelles.—M. B.

65. *Musca domestica* Linn. 1758.

One ♀. This species was recorded from the Seychelles by Stein as *M. niveisquama*.—M. B.

66. *Musca nebulo* Fabr. 1794.

A couple of specimens seen by me; several others not sent.

This Oriental species is also widely spread throughout the Ethiopian Region; the form described by me in 1911, Bull. Labor. Zool. Portici, vi, p. 87, as *senegalensis* Macq., is the same species; the black abdominal stripe ending at the 3rd segment, and the 4th segment being more or less darkened.—M. B.

67. *Musca* (*Biomyia*) *fasciata* Stein, Trans. Linn. Soc. London, ser. 2, Zool., xiv, 1910, p. 149.

One ♂.

This species belongs to the subgenus *Biomyia*, as already indicated by me in Bull. Soc. roy. Entom. d'Egypte (1922), 1923, p. 113; it has well-developed praesutural dorsocentral bristles, and is thus closely allied to *tempestiva* Fallén, of which it is probably a variety, differing slightly in the abdominal pattern. If this be true, it is a palaearctic species, recorded (as *fasciata*) from the Seychelles, and even from Formosa.—M. B.

68. *Cryptolucilia* (*Pseudopyrellia*) *cyanea* (Fabr.).

Musca cyanea Fabr. 1781.
Pyrellia flavicalyptrata Macquart 1855.
Cosmina diademata Bigot 1878.
Cryptolucilia cyanea Stein, Arch. Naturg. lxxxiii, A (1917), Heft 1, p. 105 (1919).

A dozen specimens of both sexes of this elegant fly, which is widely distributed over East Africa, and very common.—M. B.

Tachinidae.

Calliphorinae.

69. *Pycnosoma albiceps* (Wiedemann).

Musca albiceps Wied., Zool. Mag., i, 3, p. 38, 1819.

One ♂. This species was described from South Africa.—M. B.

70. *Cosmina basalis* (Smith).

Pollenia basalis Smith (*nec* Macquart), Ann. Mag. Nat. Hist. (4), xvii, p. 449, 1876; Phil. Trans. Roy. Soc., clxviii, p. 538, 1879.

Originally described from Rodriguez as one of Macquart's species, but in reality as a new species, because there is no species described by Macquart with this name. The insect is not represented in the collection before me; but it seems to be closely allied with *cuprina* Bigot from Madagascar, recorded also by Dr. Villeneuve in 1913; the latter fly, however, is described as having yellow palpi. —M. B.

71. *Stomatorrhina* (*Idia*) *lunata* Fabricius 1805; Villeneuve, Rev. Zool. Afric., iv, 1914, p. 203.

Ten ♂, 15 ♀, all examined by me. In nearly all the female specimens there are no yellow marks on the abdomen.

This Mediterranean species is recorded from Central and South Africa and from Madagascar, but not from the Seychelles.—M. B.

72. *Rhinia apicalis* Wiedemann 1830; Villeneuve, Rev. Zool. Afric., iv, 1914, p. 203.

Five ♂, 5 ♀, all examined by me. The specimens agree very well with others from the Canary Islands, also with those from the Seychelles recorded by Stein, and with the typical form as described by Dr. Villeneuve. It is known from the whole Ethiopian Region and from Madagascar.

The allied *Rh. scotti* Stein, Trans. Linn. Soc. London, Ser. 2, Zool., xiv, 1910, p. 162, from the Seychelles, is quite distinct from *apicalis*, as well as from *nigricornis* Macquart,

winthemi B.B., *testacea* R.-D., and *coxendix* Vill., according to Dr. Villeneuve's descriptions.—M. B.

Sarcophaginae.

73. *Sarcophaga haemorrhoidalis* Fallén 1816.

Two ♂ and 2 ♀ submitted to me, and 2 other ♀ which I have not seen. A cosmopolitan species.—M. B.

74. *Sarcophaga* sp. ♀.

A small species, with black ventral plates. One ♀ specimen.—M. B.

75. *Sarcophaga mutata* Smith.

Sarcophaga mutata Smith, Ann. Mag. Nat. Hist. (4), xvii, p. 450, 1876; Phil. Trans. R. Soc., clxviii, p. 538, 1879.

An unrecognisable species, superficially described from 2 female specimens from Rodriguez : not in this collection. —M. B.

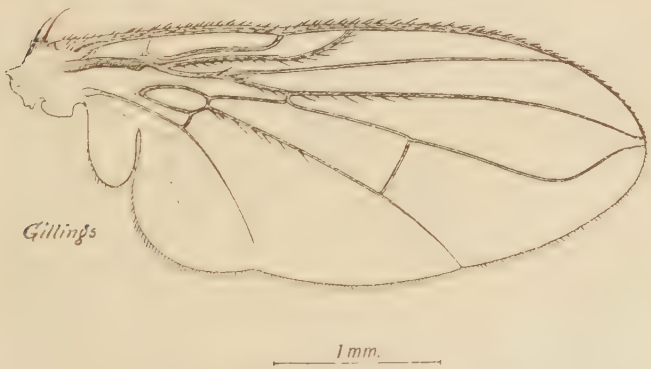


Fig. 17.—*Actia rejecta* n. sp., ♀, wing.

Tachininae.

76. *Actia rejecta* n. sp.

Agreeing in all the plastic characters with the new species *chrysocera* * from the Seychelles, but distinguished by the darker coloration, the black femora and the black wing-veins.

Type ♀, a single specimen.

* Bezzi, "Parasitology" (Cambridge) xv, 1923, p. 96, fig. 7.

♀. Length of body 4 mm.; of wing 3·8 mm. *Head* and antennae as in *chrysocera*, but of a more yellow rather than of a bright orange colour; the third antennal segment is narrower, and is distinctly darkened on the apical portion and along the fore border; the arista is more thickened and has shorter pubescence. *Thorax* entirely clothed with a grey tomentum, as is the scutellum, which is not yellow at the hind border. *Abdomen* dark yellow, moderately shining, with broad white-shining basal bands on the 2nd–4th segments. First segment with a black middle stripe, which is not dilated behind and is abbreviated forwards; 2nd and 3rd segments with a similar stripe, dilated behind in the shape of a transverse band, which, however, is not prolonged to reach the sides; 4th segment with only a black rounded middle spot near the base. *Legs* almost entirely black; coxae yellowish; front femora and tibiae yellowish below. *Wings* with the same ciliation as in *chrysocera*, but with all the veins black.—M. B.

Clistorrhinia nov. gen.

A new genus of the section *Rhinometopia* of Brauer and Bergenstamm, erected for an elegant fly of smaller size, characterised by its closed and stalked first posterior cell.

The genus *Myxarchiclops* Villeneuve (1916) shows some affinity, but is very different in the form and ciliation of the head.

Head broader above than below, its lower border being very short in profile. Mouth border prominent, more so in the female than in the male; the long vibrissa is placed exactly on the mouth margin. Peristomialia narrow. Frons of about the same breadth in both sexes, but in the male destitute of exterior orbitals. Parafacialia bare, becoming very narrow inferiorly; sides of face with 4–5 strong bristles ascending to reach the orbitals. Eyes bare. Antennae long, inserted near the middle of the eyes, with the 3rd segment extending to the mouth border, about 4 times as long as the 2nd segment, obtuse at the end, broader in the male than in the female. Arista bare, thickened on its basal half, with the basal segments very small. Palpi proportionally thin and less club-shaped; proboscis short. Ocellars strong and long, directed forwards and moderately diverging; female with 2 exterior orbitals only on each side; orbitals descending in one row to the end of the second antennal segment. *Thorax* with 3 dorso-centrals beyond the suture; scutellum with 2 pairs of very long lateral bristles, and 1 pair of smaller apical ones, which are decussate and rather erect. Sternopleurals with a smaller one placed below the anterior. Lower squama of calypters very broad and bare.

Abdomen with marginal bristles only, the 3 basal segments with a middle pair, the apical segment with a complete row. Male genitalia small and concealed; the female has the last abdominal segment more elongate than the male, of triangular shape; the ovipositor is rather long and like that of *Musca*. Abdominal sternites without special ciliation. *Legs* short and stout; hind tibiae not ciliated; tarsi simple in both sexes and in both with equal claws and pulvilli. *Wings* with a well-developed costal bristle. First posterior cell ending much before the tip of the wing, closed, and

Fig. 18.—*Clistorrhinia aurifrons* n. gen., n. sp., ♂.

provided with a rather long stalk; bend of the fourth vein a right angle, provided with a well-developed appendix, which is partly chitinised; apical cross-vein nearly straight, placed obliquely, only a little concave at the base; hind cross-vein a little less oblique than, nearly parallel with, the apical one, midway between the cubitus and the small cross-vein or nearer to the latter; small cross-vein placed before the end of the first longitudinal vein. First longitudinal vein bare; third vein ciliated up to the small cross-vein, which is placed near the middle of the discal cell. The first posterior cell and the discal cell are proportionally narrow, the veins being thus more approximate to the fore border of wing, the hind half of which is practically destitute of veins.

Genotype: the following species.

77. *Clistorrhinia aurifrons* n. sp.

Type ♂, type ♀ and two other specimens submitted to me; about 44 others not sent.

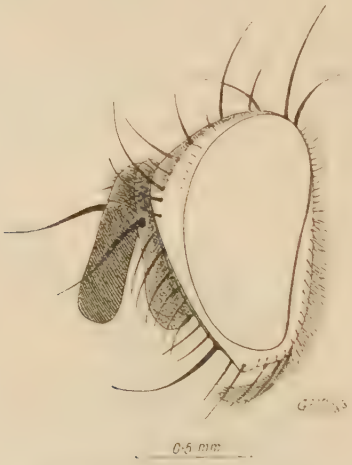


Fig. 19.—*Clistorrhinia aurifrons* n. sp., ♂, head.

♂♀. Length of body 3–3·5 mm.; of wing 2·5–3 mm. *Head* densely clothed with grey dust, which is golden on the parafrontalia and silvery on the parafacialia and on the face. Frontal stripe

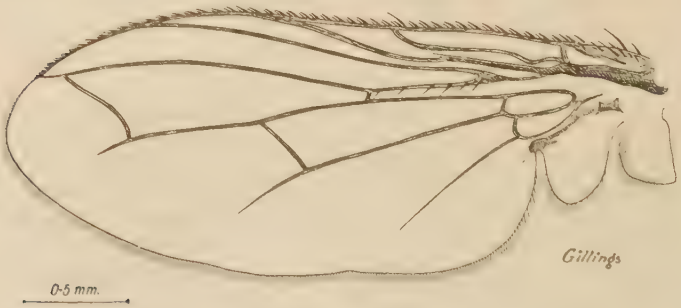


Fig. 20.—*Clistorrhinia aurifrons* n. sp., ♂, wing.

deep black, with reddish-brown reflections on the anterior half, chiefly in the female. Antennae and arista entirely black; palpi dark yellowish; proboscis black. All the bristles black; the rather short occipital hairs are white. *Thorax* shining black; on

the dorsum of the mesonotum there is a middle longitudinal stripe of white tomentum, and a broader lateral one on each side in contact with the notopleural line; the dorsum can thus be said to be grey with 2 very broad black longitudinal stripes. Pleurae black, with a broad oblique white stripe on the mesopleura and sternopleura. Scutellum shining black, white dusted on the sides. Halteres with yellowish stalk and blackish knob; calypters white. All the bristles black. *Abdomen* shining black; 2nd, 3rd and 4th segments with a broad complete basal band of white shining dust, which is a little yellowish towards the middle. Venter black. Legs quite black. *Wings* greyish hyaline, with a faint yellowish tint along the front border and near the base. Veins black.—M. B.

78. *Phryxe* sp.

One ♀, differing from *Ph. vulgaris* in the distinctly narrower frons of the female, but agreeing in other details. Only one of the erect apical scutellar bristles is present, the apex of the scutellum being damaged.—M. B.

Oestrinae.

79. *Oestrus ovis* L.

In the Cambridge Museum there is a single specimen of this species which bears the label, "Rodriguez, F. Sinclair." *—C. G. L.

* [I have been unable to trace any particulars regarding this specimen, which was in the Museum before my time. The pin with which it is transfixed appears to be of an old kind, but the head of the pin has been cut off, and the insect mounted on a stage, in recent years. The name "F. Sinclair" may refer to the late Mr. F. G. Sinclair (formerly Heathcote), the writer on Myriopoda; so far as I have been able to discover, this gentleman was never in Rodriguez, but he may have received specimens through a friend (possibly through the late Sir Edward Newton, a Government official in Mauritius and brother of the late Professor Alfred Newton) and have passed them on to the Museum.—Hugh Scott.]

XXIV. *Defensive Colour and Pattern in four Caterpillars from British Guiana.*

By Maud D. Haviland, F.E.S. (Mrs. H. H. Brindley). Including an Appendix, with Plate LV by Professor E. B. Poulton, D.Sc., F.R.S.

[Read November 18th, 1925.]

Plate LIV and Two Text-figures.

The following notes were made in 1922, during six months spent in British Guiana. Unfortunately only in the first instance was it possible to rear the imago, and in the other cases identification depends on the larval characters only.

(1) The larva of an undetermined brown and yellow *Prepona* (Nymphalinae) taken on a low shrub in the jungle near the Research Laboratory at Kartabo on the Mazzaruni River. (See Pl. LIV, fig. 1, from a photograph of the living larva.)

The larva, which was about 7·0 cm. in length, was dull leaf-green in colour, streaked faintly upon the sides of the abdomen, and more strongly upon the thorax, with darker green, and speckled here and there with minute pale spots which were scarcely visible without a lens. The anal segment and caudal fork were brown. The head, which was brown, was sharply constricted from the body and was provided with two white-tipped processes or "horns." On either side of the second abdominal segment was a round raised mark, consisting of a dark field within which were arranged a number of small opalescent pink and blue spots like facets. When stimulated by a touch, or in one case by an ant running over it, the larva contracted sharply: the head was flattened and drawn back, and the anterior part of the body was inflated. The two spots now stood out prominently, and the facets appeared to shine quite brightly. This was so striking that at first I thought the marks were actually luminous organs, but examination after dark showed that this was not the case, and that the apparent luminosity was probably due in some way to refraction. The caterpillar transformed in the course of the night, and so no further study could be made. The pupa, which was suspended from a twig of the food-plant, was sage-green with a pale blue spot behind each spiracle. The imago emerged about four weeks later,

and is now in the collection of the Zoological Society of New York.

In the "alarm" attitude, this caterpillar was of formidable appearance, since the resemblance to the head of a green snake or lizard with open mouth and protruding gleaming eyes was remarkable. The anterior margin of the inflated thorax represented the lips, and the retracted head gave the impression of a dark tongue thrust out between them. In the photograph, the white tips to the cephalic processes suggest the teeth of the supposed reptile, but this effect was not so striking in life.

I am indebted to Professor Poulton for calling my attention to the caterpillar of *Prepona amphimachus* described by Wilhelm Müller,* which is evidently very similar to the Kartabo specimen. The minute pale metallic spots, mentioned by Müller, can be made out clearly in the original photograph.

(2) A Sphingid larva collected on a shrub at Plantation Diamond, Demerara. (See Pl. LIV, fig. 2, from coloured sketches.) This caterpillar, about 4 cm. in length, was bright brown, with dark median and lateral stripes and cauda, and yellow spiracles. When irritated, it raised the anterior part of the body, folded the thoracic legs inwards, and displayed two pairs of conspicuous ocellated markings, which when the insect was at rest, were concealed in the intersegmental folds. These "eye-spots" each consisted of a golden outer ring with an intense velvety black centre. They did not suggest specific mimicry, unless perhaps a general resemblance to a spider.

(3) A Notodontid larva taken on a vine in the Botanical Gardens at Georgetown. (See Pl. LIV, fig. 3, from coloured sketches.) In the attitude of repose, this caterpillar, which was 2·5–3·0 cm. in length, was indistinguishable from a dead twig in its brown colour and irregular outline. When irritated, however, the caterpillar raised the anterior and posterior thirds of the body; and throwing the head back into a horizontal position, thrust out a pair of turgid purple-red processes between the first and second, and second and third pairs of thoracic legs respectively. Small as the larva was, the transformation was decidedly startling, and gave the impression that a brightly coloured spider had suddenly leaped upon the supposed twig. These

* Zool. Jahrb. Zeitschr. f. Syst. Biol. u. Geo. der Thiere, I, 1886, p. 489, taf. xiv, f. 6.

osmeteria were situated on the basal joints of the second and third pairs of legs: I was not able to detect that any odour accompanied their eversion.

(4) A Limacodid larva taken at Kartabo in June. The caterpillar was exceedingly inert and sluggish, and fed on the upper surface of leaves in clearings (See Pl. LIV, fig. 4, from a photograph of the living larva.)

In the earliest observed stage the caterpillar was 1·25 cm. in length, and provided with three series of lateral appendages. The first series consisted of five pairs of processes, inserted on either side of the dorso-median line. The first pair (short) projected forwards over the head: the second (short) and the third, fourth and fifth pairs (long) extended out on either side of the body and were somewhat recurved. It was these long processes which, by their likeness to the pedipalpi and four legs, gave the caterpillar its resemblance to a spider. The processes were thickly clothed with short plumose hairs and bore in addition many longer scattered setae. The three posterior pairs each possessed a circular eminence at their bases. These were covered with lighter-coloured hairs and simulated the eyes of the spider.

The second series of processes were similar to the first, but straight and much smaller. There were five pairs—three situated between and below the posterior three pairs of long processes, and two projecting back over the anus.

The third series of processes consisted of eleven pairs of short conical tubercles situated along the body beneath the other processes. In addition, there was a pair of small anal appendages. At this stage the caterpillar was bright brown with buff dorsal marks.

In the next stage the caterpillar was 2 cm. in length, with grey hairs and red dorsal "eye" markings. In general form it resembled the earlier instar, but the pilose coat was much thicker. The dorsal eminences were also more pronounced. Each long process was tipped with a brush of black hairs—an excellent representation of the hairy tarsi of a spider. Each process of each series (except the anal appendages) ended in a single short seta with a swollen base in which the medulla or central fibre of the process terminated—a fact which suggests the homology of these remarkable appendages.

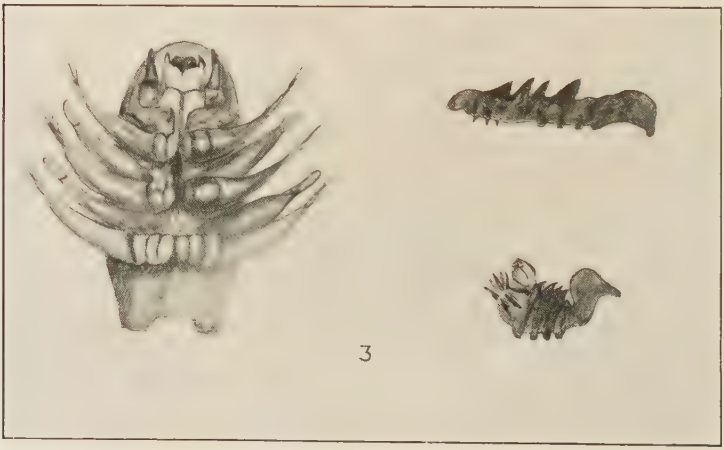
The processes of the second and third series were loosely fastened to the body, and in spirit specimens are readily

detached. Viewed as a transparency, each seems to consist of a sac of gelatinous substance (or fluid) with a central cone or medulla. They are inserted by a sort of double condyle into a depression of the body wall, and the medulla enters by a small aperture (*a* in Text-figs. 1 and 1A) with a chitinised rim. It is evident that in life they could be broken off with the minimum of bleeding or tissue lesion. This was

Fig. 1.

Fig. 1A.

well illustrated by another Limacodid larva, also of Arachnid type, which I found at Kartabo in August. It was about 1 cm. in length, with hairy appendages disposed as in the form just described; but the hairs, which were long, stiff, and scattered, appeared to be embedded in a kind of orange jelly, covered with a thin transparent epidermis. The larva was carried home in a box and on inspection half an hour later it was found that the appendages had been shed (? autotomised); and that all that was left was a little bristly larva which bore no mark of a wound, although it had got rid of at least half of its total apparent bulk.



Mrs. H. H. Brindley del et. phot. *Vaus & Crampton, Ltd.*

DEFENSIVE COLOUR AND PATTERN IN BRITISH GUIANA CATERPILLARS.

Explanation of Plate LIV.

Illustrating Maud D. Haviland's (Mrs. H. H. Brindley's) paper on "Defensive Colour and Pattern in four Caterpillars from British Guiana."

The figures are from photographs or sketches by the author.

Fig. 1. The mature larva of an undetermined species of *Prepona* (Nymphalinae), taken at Kartabo. The figure shows the appearance assumed when the larva is disturbed. About $\frac{7}{8}$ natural size; from a photograph of the living larva.

2. A Sphingid larva from Plantation Diamond, Demerara. The lower fig. is reduced to little more than half the natural size. The upper fig., greatly enlarged, represents the position assumed on disturbance by the anterior part of the larva which is seen to be raised, showing the infolded thoracic legs and the two pairs of black yellow-ringed eye-spots. These conspicuous markings are seen on the ventral aspect of the second and third thoracic segments. From coloured sketches of the living larva.

3. A Notodontid larva from the Botanical Gardens, Georgetown. The larva is shown of about the natural size before and after disturbance, together with a greatly enlarged representation of the raised anterior segments as seen from the front, showing the pair of purple-red processes everted from the second and third thoracic segments when the larva is disturbed. From coloured sketches of the living larva.

4. A Limacodid larva taken at Kartabo. The spider-like appearance is well shown. About natural size, from a photograph of the living larva on the upper surface of a leaf.

Appendix, by Professor E. B. Poulton, D.Sc., F.R.S.

Plate LV.

Thinking it would be a convenience to naturalists that other examples, confirming and extending Mrs. Brindley's interesting observations, should appear with them, I have, with her consent, written this appendix and added a second plate to the paper.

Centroctena rutherfordi Druce.—This African Sphingid larva, described by Dr. V. G. L. van Someren in Proc. Ent. Soc. Lond., 1923, pp. lxxix, lxxx, resembles the *Prepona* larva represented in Pl. LIV, fig. 1, in that the eye-like marks become prominent in the terrifying attitude. Knowing my wish to reproduce a photograph of this larva from life in the position of rest (Pl. LV, fig. 1) and when disturbed (fig. 2), Dr. van Someren kindly prepared the excellent prints from which these figures have been taken. He informs me that "there are several 'eyed' Sphinx larvae in the Nairobi district (but not with the 'labial scales' [*ibid.* p. lxxx] as in *C. rutherfordi*) which expose and extrude the 'eyes' in the terrifying attitude."

Further observations on the eye-spots of Sphingid larvae with evidence of their success in terrifying man as well as their natural enemies are recorded in Trans. Ent. Soc. Lond., 1902, pp. 397–401, and the references there quoted: also in Proc. Ent. Soc., 1905, pp. xxii, xxiii. For beautiful figures of various forms of eye-spots in a large number of S. American Sphingid larvae see the Rev. A. Miles Moss in Trans. Zool. Soc. Lond., xx, ii, No. 1 (1912), and Nov. Zool., xxvii, No. 2, p. 333 (1920). Naturalists owe a deep debt of gratitude to the author, the Zoological Society and Lord Rothschild, F.R.S., Ph.D., for the splendid illustrations accompanying these memoirs.

The terrifying attitude of the African Sphingid larva Hypaedalea butleri Rothsch.—Mr. A. W. J. Pomeroy when recently in England called my attention to the Cobra-like attitude of this larva when disturbed, and kindly gave me the photograph, taken from life, which is reproduced on Pl. LV, fig. 3. He informed me that the effect is greatly increased by the suddenness with which the attitude is assumed, as it is by our own *Pergesa* (*Choerocampa*) *elpenor* L., and probably all such Sphingid larvae as well as by the Cobra itself. A somewhat similar flattened expansion

of the anterior abdominal segments with dorso-lateral eye-spots is shown by the Rev. A. Miles Moss in *Oryba achemenides* Cram. (Nov. Zool. xxvii. Pl. V, fig. 2*e*) and in the fourth instar of *Leucorhampha ornata* Rothsch. (Pl. X, fig. 7), which in a later stage develops eye-spots on the ventral surface (see below).

Terrifying marks on the ventral surface of Sphingid Larvae. Dr. Karl Jordan, after looking at the original photograph of Mrs. Brindley's Pl. LIV, fig. 2, suggested to me that the larva may be that of *Perigonia lusca* F., of which Mr. Miles Moss, under the f. *restituta* Walk., writes:—

"This and the succeeding species of *Eupyrrhoglossum* and *Scia* share a feature in common which is calculated to terrify away intruders. I refer to a certain strained attitude sometimes adopted, these larvae when disturbed throwing their heads back and exhibiting large lunules of velvety black in cadmium or lemon yellow settings, on the ventral area of the second and third thorax or leg segments." (*Ibid.*, p. 400.)

The larva, in the final instar (*ibid.*, Pl. VII, fig. 13), although a green and not a brown form, possessed a shape and pattern very like that of Mrs. Brindley's Pl. LIV, fig. 2. The black, yellow-ringed eye-spots are represented as visible in a side view. There can be little doubt that the terrifying effect is largely due to the suddenness of the transformation from a procryptic to a conspicuous appearance. The black marks of *Perigonia* and the other genera are of special interest in that they exhibit the simple and primitive form of a ventral marking which is highly developed in other Sphingid larvae figured by Mr. Miles Moss. Thus, writing of *Leucorhampha triptolemus* Cram. (*ibid.*, pp. 391, 392, Pl. IX, figs. 5*a*, 5*b*, 5*c*) and *L. ornata* Rothsch. (Pl. VI, figs. 1*e*, 1*f*, 1*g*, 1*h*, 1*j*; Pl. X, fig. 7)—for the description applies equally well to both species—he gives the following account of the startling transformation:—

"The larva is quite one of the most remarkable of living creatures that I have ever seen, a perfect Aaron's rod, combining in the most novel and striking way the principles of protective resemblance with an aggressive snake-mimicry. When at rest as an adult caterpillar, it hangs by two pairs of claspers in the vertical from the stem of its food-plant, and appears to be nothing but a broken branch covered with a dull, creamy-white lichen. A strange black-chequered dorsal design, with a gradual

intensification of the grey on certain segments completes the deception. The wonder, however, is if possible exceeded when, on being disturbed, this marvel of creative evolution endeavours once more to deceive by turning into a snake, and in quite a different way to that adopted by *Xylophanes* or even by its fairly close relative *Madoryx pluto*. Though this wonderful transformation wants to be seen in life to be fully appreciated, I may explain briefly that the effect is produced by the creature turning itself over and exhibiting its ventral area, which is adorned by a broad band of dark olive-green with the three anterior sets of claspers completely withdrawn and scarcely visible. The thoracic segments, which are always swollen, become puffed out laterally to an exaggerated extent; a pair of black eyes on segment 4, hitherto concealed and situated behind the now recumbent and wholly inconspicuous legs, open out; the cheeks appear to be adorned by yellow scales with black edges; and the fraudulent notion that one is beholding merely the head and neck of a formidable, if small, snake is carried to a nicety by the rigidity of the curve adopted. Then, as if to mesmerize, a swaying side-to-side motion is kept up for an appreciable number of seconds, before the creature, seeming to realise that an attack is no further contemplated, gradually closes it false eyes and relapses once more into diurnal slumber. That this mimicry of the fore-part of a small serpent, if mimicry it be, for it is hard to give it any other name, should be chiefly produced on the ventral surface, a feature peculiar in itself, and that every detail should so contribute in perfecting the deception, is altogether remarkable."

Most naturalists will, I believe, agree that these words, with the beautiful figures accompanying them, indicate that the snake-like caterpillar, described by H. W. Bates in his classical paper, was not a Notodont, as the Rev. Joseph Greene supposed, but one of the two species of *Leucorhampha* or a Sphingid larva closely allied to them. The passage is as follows:—

"The most extraordinary instance of imitation I ever met with was that of a very large Caterpillar, which stretched itself from amidst the foliage of a tree which I was one day examining, and startled me by its resemblance to a small Snake. The first three segments behind the head were dilatable at the will of the insect, and had on each side a large black pupillated spot, which resembled the eye of the reptile: it was a poisonous or viperine species mimicked,

and not an innocuous or colubrine Snake; this was proved by the imitation of keeled scales on the crown, which was produced by the recumbent feet, as the Caterpillar threw itself backwards. . . . I carried off the Caterpillar, and alarmed every one in the village where I was then living, to whom I showed it. It unfortunately died before reaching the adult state." (Trans. Linn. Soc. Lond., vol. xxiii, p. 509, 1862.)

Remembering that Bates wrote his paper after his return from the Amazon the resemblance between his description and that of Mr. Miles Moss is remarkable. The fact that these caterpillars in their later stages have the caudal horn reduced to a mere hump would doubtless have prevented Bates from recognising his larva as a Sphingid.

In the copy of the classical memoir, given to me by Wallace and presented to him by "his old travelling companion the author," the passage I have quoted is specially marked in pencil. For over sixty years it has attracted attention and interest, and it is a great satisfaction to be enabled, by means of Mr. Miles Moss's description and figures, at length to determine the kind of larva referred to by the great naturalist of the Amazon.

The Limacodid larva Doratifera vulnerans Lewin at rest and when disturbed.—Mr. A. J. Nicholson, Lecturer in Entomology at the University of Sydney, during his recent visit to this country, kindly gave me the two excellent photographs of this interesting larva, reproduced, about twice the natural size, on Pl. LV, figs. 4 and 5. The sudden transformation effected, on the slightest disturbance, by the eversion of the spine-bearing tubercles is well shown in the two figures. The photographs were taken at Sydney in 1924.

Commander J. J. Walker wrote of this caterpillar in Ent. Monthly Mag., Vol. 41, pp. 229, 230 (1905), as follows: "One of the most objectionable insects in the 'bush' is the larva . . . which is often found in very undesirable profusion on young *Eucalyptus* foliage in early summer. It is a stout, bright green, slug-like creature varied with yellow, with rose-coloured tubercles, each bearing a circular series of mobile stiff hairs or spines. The slightest touch of these hairs causes a sensation like that of the sting of a nettle, only worse, which soon subsides, but remains perceptible for several hours afterwards."

There can be little doubt that the detachable processes described by Mrs. Brindley (p. 578) serve the same purpose.

Explanation of Plate LV.

Illustrating Professor E. B. Poulton's Appendix to Maud D. Haviland's (Mrs. H. H. Brindley's) paper on "Defensive Colour and Pattern in four Caterpillars from British Guiana."

Figs. 1–3, natural size; 4 and 5 about twice natural size.

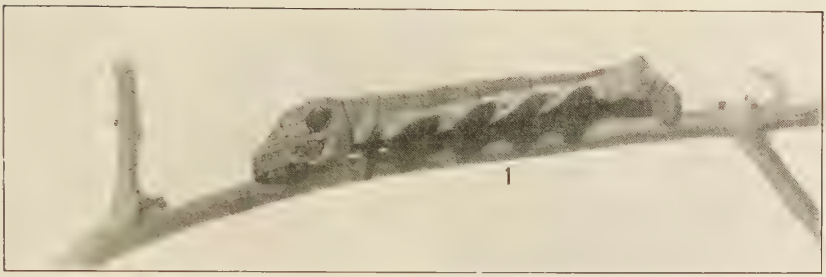
Fig. 1. The larva of the Sphingid moth *Centroctena rutherfordi* Druce, in the last stage. From a photograph of the larva in the position of rest, by Dr. V. G. L. van Someren. Nairobi, Kenya Colony.

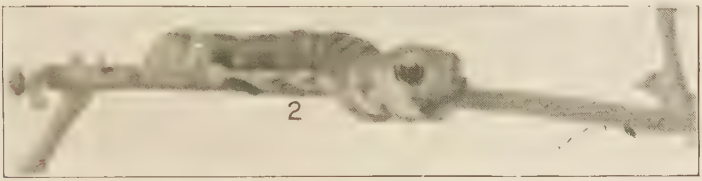
2. The same in the terrifying attitude assumed on disturbance. The prominent "eyes" and snake-like curve are well shown; as also the depression of the hump to which the caudal horn is reduced in this stage. The simulated labial scales and tongue, described in Proc. Ent. Soc., 1923, pp. lxxix, lxxx, are not seen. From a photograph of the living larva by Dr. van Someren.

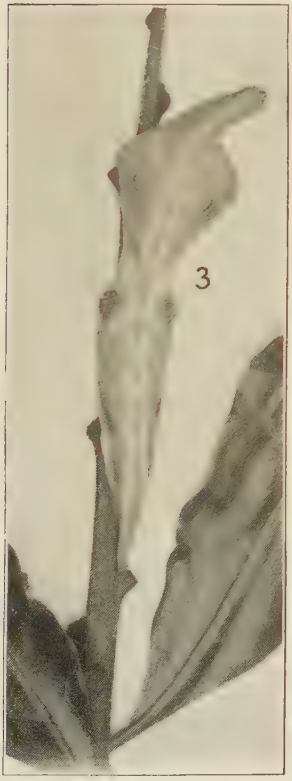
3. The mature larva of the Sphingid moth *Hypaedalea butleri* Rothsch. in the terrifying Cobra-like attitude it assumes with startling suddenness when disturbed. From a photograph of the living larva by Mr. A. W. J. Pomeroy. Ibadan, S. Nigeria.

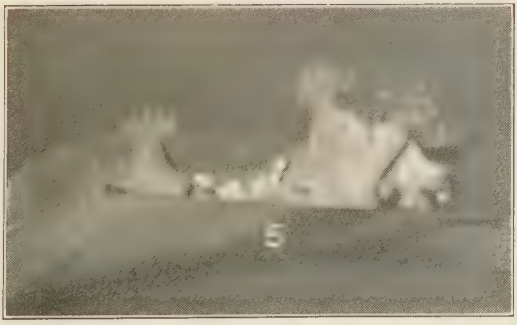
4. The mature larva of the Limacodid moth *Doratifera vulnerans* Lewin in the position of rest. From a photograph of the living larva by Mr. A. J. Nicholson. Sydney, N.S.W.

5. The same when the branch on which it is resting is even slightly shaken. The tubercles are seen to be everted and their crown of irritating bristles to become prominent. From a photograph of the living larva by Mr. Nicholson.









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TERRIFYING AND WARNING ATTITUDES IN CATERPILLARS.

XXV. *On the Presence of an Egg-burster in* Aphididae.

By C. T. Gimingham, F.I.C., Rothamsted Experimental Station, Harpenden.

[Read November 18th, 1925.]

With Two Text-figures.

In the course of some work on the egg-killing power of various chemicals, an opportunity presented itself of following the hatching of the fundatrix in some species of Aphididae. It was of interest to find that the preliminary operation of breaking open the chorion is accomplished by means of a saw-like "egg-burster" -a comparatively large, heavily chitinised ridge on the head of the nymph, which is left behind on complete emergence. A structure of this type is well known in the Neuroptera (4, 12, 13, 14, 15), in the hemipterous families, Pentatomidae and Coreidae (2, 5, 8), in the Psocids (7), and in other insects.

Its occurrence in Aphides is, however, apparently not so generally known and appears to have been frequently overlooked. It will therefore perhaps serve a useful purpose to put together a short account of what is known of this rather striking organ.

The process of eclosion from the over-wintered egg was closely followed on several occasions in the species *Amphorophora lactucae* Kalt.*

The eggs are normally laid near the base of the buds of currants and gooseberries, and, in this case, were found on black currants in a garden at Harpenden.

Owing to the opaque black shell of the egg, the initial movements of the embryo, when ready to hatch, were not seen; but by some means, pressure is exerted at the head end. The chorion breaks over the vertex and the nymph, completely enveloped in a transparent embryonic skin, slowly pushes out head foremost, the egg gradually splitting along its length. Over the vertex of the head and extending backward as far as the eyes is a dark brown chitinous toothed ridge, tapering at each end, which undoubtedly serves to break open the egg. The nymph stands straight

* Dr. J. Davidson of the Rothamsted Expt. Station, very kindly helped with the identification of this and the other species referred to.

up, almost at right-angles to the length of the egg (Fig. 1), and, with slight swaying movements, continues to emerge until held only by the apex of the abdomen, which is supported inside the chorion. It is remarkable that, up to this stage, neither legs nor antennae are free; they can be seen, folded on the body, through the thin enclosing skin. The egg-burster, which is very prominent on the head, then begins to slide down the side of the body, at first rapidly, and then very much more slowly after reaching the position of the posterior legs, *i.e.* the nymph is emerging from, or moulting, the embryonic skin in which it was enclosed. It can be seen that the egg-burster is attached to this membrane and that the area around its base is stouter, slightly brownish in colour and not completely transparent. The rupture of the skin occurs along one

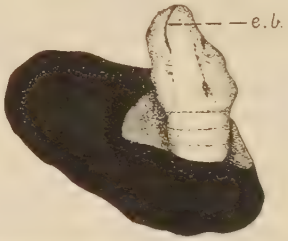

Fig. 1.—*Amphorophora lactucae* Kalt. Nymph emerging from egg. *e.b.*, egg-burster.

side of the base of the egg-burster, where the thicker brownish area merges into the remainder. As the nymph pushes out of its embryonic membrane, the antennae, anterior and intermediate legs become free one by one, the insect remaining in an upright position supported on the tip of the abdomen. The freeing of the posterior legs is a slow and apparently difficult operation, but finally all the appendages are at liberty and waving in the air. The nymph now gradually gets into an inclined position, falls slowly on to the bark of the twig on which the egg is situated, and exercises legs and antennae for some minutes. The abdomen is still attached to the interior of the egg by a small mass of stiff, gum-like cement which is evidently the support during the earlier stages of emergence. After a short rest, the young insect pulls itself free (a considerable effort is required), leaving the crumpled skin, with the egg-burster, attached to the empty egg-shell. The whole process of

eclosion is very gradual and slow; watched under the microscope, it occupied more than an hour.

On one occasion a nymph was found lying on a twig just free from the egg, but still enclosed in the embryonic membrane with the egg-burster in position on the head. When looked at two hours later the insect was free, and on the spot where it had previously been seen were the crumpled skin and egg-burster. Normally, however, the process appears to be as described above, though whether it takes as long as one hour for completion under natural conditions is open to doubt.

The egg-burster, which is a most efficient-looking apparatus, can easily be found on dissecting out the embryos

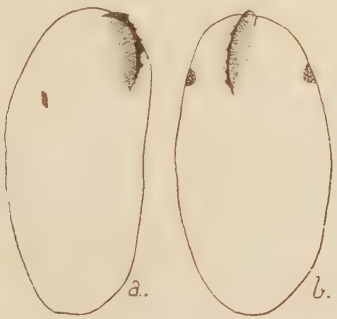

Fig. 2.—*Amphorophora lactucae* Kalt. Outline of embryo from unhatched winter-egg showing egg-burster.

(*a*) Lateral view: the egg-burster is pushed somewhat out of the natural position.

(*b*) Dorsal view.

from unhatched eggs of *A. lactucae* in an advanced stage of development (Fig. 2). Precisely similar structures, varying somewhat in size and number of teeth, were found on embryos of *Phorodon humuli* Schr. and *Aphis pomi* De G. At the time these observations were made (March and April 1925) it was too late to find unhatched eggs of other species, but it is hoped that it will be possible to examine a larger number next spring.

It seems not improbable that the occurrence of an egg-burster is common among Aphides; and on finding it in *Amphorophora lactucae*, a search was made in the literature. Four references only have been noted. An egg-burster was described and figured in 1900 by Nüsslin (9) as present

in *Mindarus abietinus* Koch and *M. obliquus* Cholodk; and in 1904, by Flögel (3) (who calls it a head-saw (Kopfsäge)), in *Aphis betulicola* Kalt (*Therioaphis betulicola*), *Aphis oblonga* Heyd. (*Symydobius oblongus*) and *Vacuna betulae* (? *Glyphina betulae* Kalt). Both authors refer to the organ as "hitherto undescribed," and no mention of its existence has been found in a considerable number of earlier papers on the biology of Aphides which have been looked through. It was also recorded (in 1916) as present in *Aphis pomi* De G., by Baker and Turner (1), and in *Aphis pomi* and in *Aphis avenae* F. by Peterson (10) in 1919.

The process of eclosion from the egg is dealt with in some detail by Nüsslin and by Flögel, and there are brief notes on the subject in the papers by Baker and Turner and by Peterson. These accounts agree in most particulars with that given above for the emergence of *Amphorophora lactucae*. The details of the process are evidently very similar in the various species, though the attachment of the abdomen to the interior of the chorion by a gummy material does not seem to have been previously mentioned. The curious slow extrusion of the insect from the egg while still enclosed in the embryonic membrane, apparently by pressure from below and without any help from the legs, and also the shedding of the membrane with the attached egg-burster, have been observed in all cases.

The nature of this membrane is not clearly understood. It appears that in all insects in which an egg-burster is known, it is situated on, and is a thickening of, a thin chitinous enveloping skin which is shed at hatching * and left behind attached to the empty egg (cf. Smith, 11). It was thought to be the amnion by earlier observers, and, with some reservation, this view was accepted by Withycombe in his paper on "The Biology of Some British Neuroptera" (14).

Heymons (6) and Smith (*loc. cit.*) consider it to be an embryonic moult in the Pentatomidae and in the Neuroptera and probably in other insects also. In a later publication (15), Withycombe also inclines to this view, but prefers, until the matter is settled beyond doubt, to call it the prelarval skin. In the Neuroptera, this skin sheathes all the appendages of the insect separately, but this does not

* There are some exceptions: *e.g.* the Pulicidae are said to retain the egg-burster for a day or longer after hatching.

appear to be the case in the Aphididae, the insect being enveloped by the membrane as a whole. There seems to be a fundamental difference in the two cases; and it would appear to fit the facts as at present known to regard the membrane as a true (embryonic) moult when the appendages are separately enveloped, and as a persistent amnion when the whole insect is enclosed. Various insects are known in which an embryonic membrane of this type occurs, but which do not possess an egg-burster; and evidently there is scope for further work on the origin and development of this membrane, and of the very specialised part of it which in some insects forms the egg-burster.

The writer is much indebted to Dr. A. D. Imms for his kind interest and help.

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XXVI. *Observations on the Habits and Parthenogenesis of* ♀ Methoca ichneumonides *Latr.* [*Hymenoptera, Vespoidea*]. By H. T. Pagden (Christ's College, Cambridge). (Communicated by Hugh Scott, M.A., Sc.D., F.E.S.)

[Read December 2nd, 1925].

In July 1924 I collected some females of the Thynnid, *Methoca ichneumonides* Latr., for the purpose of breeding from them and finding out if possible a reason for the scarcity, or apparent scarcity, of the male of this insect. It has been suggested that the males were overlooked by collectors, that their life was probably of short duration, ending soon after pairing, and that their scarcity was only apparent. Supposing this to be the case, I hoped to be able to breed a good series of males if only enough ovipositions in captivity could be obtained, as it would not be unreasonable to expect an approximately even division of the sexes. On the other hand, I thought that there might be some other cause of the scarcity of the males, as it did not seem very likely that this sex would be consistently overlooked by collectors in localities where the female is quite abundant.

On July 1st, 1924, I caught a male *Methoca* at Oxshott, and this is the only living male that I have so far seen. Females were found to be very numerous round Woking and Chobham during July and a fair number were easily taken. Their prey, the larvae of Cicindelidae, appeared to be very scarce except in the young stages, which were too small to provide adequate food for a *Methoca* larva. However, enough were obtained to make possible the observation of the method employed by the *Methoca* to render the beetle larva quiescent. I adopted the Champions' method (1) of keeping the larvae by placing them in sand in glass jars or tumblers, so that one side of the burrow was formed by the glass. In every case observed the *Methoca* went down the burrow of the larva without a moment's hesitation, even when the *Cicindela* larva was of large size. A preliminary skirmish followed, in which the *Methoca* contrived to sting the larva somewhere just below the gular region or elsewhere on the ventral side of the thorax. In one case the *Methoca* had no trouble in doing this, as the larva raised its head to attack and thus left a gap between itself

and the side of its burrow, through which the *Methoca* slipped; on another occasion the *Methoca* appeared to get caught either by the head or thorax and, curving her abdomen down, delivered a sting in the neck region of the larva.* As soon as it was stung the larva let go and the *Methoca* retreated to the top of the burrow. In every case in which a large *Cicindela* larva was observed to be attacked, the *Methoca* was seen to behave in the same way as far as general tactics were concerned, though the exact manner in which she succeeded in disabling the larva was not always the same. Thus, she might have no difficulty, as in the first case recorded, or she might be caught, as in the second case just described, or, again, there might be a rough-and-tumble fight in which it was impossible to make out what was happening. But in every case, after delivering a sting, the *Methoca* retreated to the top of the burrow, where she remained motionless for a period usually of about ten minutes' duration. She then began to move very carefully and gradually, feeling her way over the edge of the burrow with her antennae, and gently tapping the larva with these organs; on receiving no response, she squeezed past the larva, commenced to sting it repeatedly on the ventral side of its thorax and gnawed or malaxated the chitin between its legs. After this process the *Methoca* would remain motionless for a short time and would then adjust the paralysed larva to the position she seemed to like best in its burrow. Oviposition probably was accomplished next, but I was never able to observe this process, as the *Methoca* usually seemed to get the ventral surface of the larva away from the glass. In those larvae which I have seen bearing an egg, the latter was placed obliquely just behind, and on the inner side of, the base of the right hind leg. In the case of two small larvae that I saw attacked, there was no retreat after the first encounter, the *Methoca* recoiling for a second or two at most.

On several occasions a *Methoca* was observed to pass the night in the burrow of a *Cicindela* larva without having previously disabled the latter in any way. This was proved because, when the *Methoca* left the next morning, the *Cicindela* larva was found to be undamaged and capable

* This agrees with the published observations of Adlerz, who thinks that the *Methoca* voluntarily lets itself be seized and by so doing paralyses the *Cicindela* larva. Whether this behaviour of the *Methoca* is entirely voluntary I am unable to say.

of feeding. The larvae treated thus were usually of medium size only, and this may possibly account for the *Methoca* not attacking them; but why they did not attack the *Methoca* I am unable to say. That the *Methoca* does occasionally get the worst of it is indicated by the fact that a small melanic *Methoca*, which I had under observation in August 1925, and which attacked and successfully disposed of a large *Cicindela* larva, was later in the day found to have been badly damaged, presumably by a small *Cicindela* larva which had a burrow in the same glass. After filling in the burrow where she had operated, the melanic *Methoca* was quite normal, but in the afternoon of the same day it was observed that she had the last three visible segments of her abdomen missing, as also were the last two segments of the left intermediate tarsus, the last three segments of the right hind tarsus and the last two segments of the right antenna. As there was nothing in the tumbler other than one paralysed and one active *Cicindela* larva, I can only ascribe these mutilations to the undamaged larva.

As regards the life history of the *Methoca* larva, I have no record, as I did not wish to disturb those in my jars, and the eggs which I got on *Cicindela* larvae in the field did not hatch. B. E. Bouwman (2), however, has written a very good account of the larva of *Methoca* up to the point of pupation, when the larva which he had under observation died. Bouwman found that the egg hatched within five days, and Adlerz (3) had five larvae which hatched within five to ten days of oviposition.

The only cocoon which I obtained from the females of *Methoca* kept in captivity in 1924 measured 8 mm. long and 3 mm. wide at the middle, and was oblong-ovate in shape. In colour it was light brown with some very pale fluffy silk on the outside, giving it a whitish appearance. From this cocoon emerged a fairly large female *Methoca* on July 16th, 1925, between 12 noon and 1 p.m. (summer time). This female was immediately placed in a glass dish with some sand and was provided with a little moist sugar until some *Cicindela* larvae could be obtained.

All the subsequent experiments were made with this female. The insect was kept in a vessel covered either with a sheet of glass or with butter muslin held in place by an elastic band, so that at no time could a male come in contact with her, even had any males been present.

To procure the *Cicindela* larvae took some time, as they appeared to be absent from their usual haunts on the Surrey heaths, but after eight days a large colony was found in West Suffolk and some good large specimens were secured, together with a pupa which proved to be that of *Cicindela campestris* L. Two large larvae were placed in holes made for them in sand in a tumbler, the bred female *Methoca* was introduced and the tumbler covered with a sheet of glass. At 6.45 p.m., about five minutes after being put in, the *Methoca* found one of the larvae and attacked at once. After the first encounter she retreated and waited at the top of the burrow, where she remained for about ten minutes, when she went down again and could be seen moving about on the larva. By 8.30 p.m. the burrow was stopped up and the second larva had been attacked. At 11 p.m. the *Methoca* was still active and was engaged in smoothing the sand over the burrow.

On the following day, July 25th, the female *Methoca* operated on a large *Cicindela* larva at 5.30 p.m. When she first attacked, the larva was head downwards in its burrow, in the widening of which it was engaged. The *Methoca* seemed quite nonplussed, but events could not be observed. At 7.15 p.m. the hole was half filled in and the larva was the right way up.

On July 26th the *Methoca* was found burrowing down to the larva on which she had operated the previous day and she was very loth to be driven away, returning again and again. As I did not want the larva to be disturbed, I removed the *Methoca* to another tumbler containing two larvae, one of which was in a burrow it had made for itself and which had a pile of excavated earth over its entrance. After investigating the other burrow, which had its entrance open, the *Methoca* went to the covered burrow and started to dig. The *Cicindela* larva came up to the attack, and its jaws could be heard snapping as the *Methoca* caused the earth to fall into the burrow. At last most of the earth was removed from the entrance, and the *Methoca* retreated and stayed still for about five minutes. She then circled round about a quarter of the periphery of the burrow and made a sudden dive at the larva, which snapped at her; but the *Methoca* escaped, and after a few moments squeezed past the cephalothoracic shield of the larva and disappeared below (2.50 p.m.). At 3.35 p.m. the *Methoca* had left the larva, without filling the burrow, and was

attacking the other larva, which had now accumulated a quantity of earth over its hole. This larva put up a great fight and once caught the *Methoca* across the thorax, but with a quantity of earth as well, which may have saved her, as she escaped, though without delivering a sting. Eventually the *Methoca* succeeded in disposing of her victim, and by 5·15 p.m. the hole was about half filled in. The first larva was lifted out and examined under a lens, but no egg was visible on its body. The second one was dug up on October 15th and found to be still alive, but only just capable of movement. This is the only record I have of a *Methoca* burrowing down to attack a *Cicindela* larva, and the proceeding may have been simply a continuation of an act which had been begun when the insect burrowed down to the paralysed larva. This latter must have already had an egg on it, as a *Methoca* cocoon was eventually found in its burrow.

July 27th: the *Methoca* attacked a larva, which was subsequently dug up for examination on August 5th, and was then found to be quite lively but incapable of co-ordinate movement. No egg of the *Methoca* was visible on this larva.

July 29th: a *Cicindela* larva was attacked at 4 p.m. and successfully disposed of. By 6.45 p.m. the *Methoca* was attacking another; this larva came up to the top of its burrow to attack her and, after the initial encounter, during which the *Methoca* was caught by the head and thrown out, the *Methoca* retired and waited for about ten minutes. Gradually she stalked up to the burrow and, on getting the tips of her antennae over the edge, darted back as the larva snapped at her. This performance was repeated several times from various angles, and the larva appeared to become gradually fatigued, the latent period between the appearance of the antennae of the *Methoca* and the snap of the larva's jaws becoming longer. Eventually the larva retreated down its burrow, and after a few seconds the *Methoca* followed it: she was caught round the thorax, but, curving her abdomen downwards, she appeared to sting the larva behind the gular region. The larva let go and the *Methoca* retreated a little way up the burrow and rested a moment, passing her antennae through her front legs. She then started to climb up, but, on reaching a slightly higher point, turned and attacked the larva again. The larva snapped its jaws several times,

but the *Methoca* squeezed past on the dorsal side of the larva and, passing round to its ventral side, stung it vigorously. By 8 p.m. the hole was mostly filled in. Both these ovipositions have ultimately produced *Methoca* cocoons.

As I had to go away on August 8th the tumblers were left each with a pad of damp cotton wool in them, and the whole lot covered with a duster. On returning on October 13th five *Methoca* cocoons were found, and all of these were the result of ovipositions by the virgin female *Methoca*.

It may be suggested that the larvae of *Cicindela* were already parasitised when collected, but, if this were the case, they would have borne eggs of the parasite, would have had their burrows stopped up, and would have been sluggish and devoid of much of their power of movement and co-ordination. Actually, no eggs of the parasite were detected on the bodies of the *Cicindela* larvae when they were collected in the field, even with the most careful examination; their holes were not filled in, and every larva used was active and in good health. Some of the larvae which were kept and not exposed to the attacks of the parasite are still alive in October.

The results may be tabulated as follows :—

Date of stinging of larva by the *Methoca*.	Time.	Result.
24.vii.25.	6.45 p.m.	Cocoon of *Methoca* ultimately produced.
	8.30 p.m.	Cocoon of *Methoca*.
25.vii.25.	5.30 p.m.	Cocoon of *Methoca*.
26.vii.25.	2.50 p.m.	Larva not buried and when lifted out of burrow showed no sign of an egg.
	3.35 p.m.	Larva dug up Oct. 15th and found to be still alive, but very weak. No sign of an egg on its body.
27.vii.25.	1.30 p.m.	Larva dug up on Aug. 5th. No oviposition by the parasite had occurred.
29.vii.25.	4 p.m.	Cocoon of *Methoca*
	6.45 p.m.	„ „ „

It can thus be seen that from eight *Cicindela* larvae attacked by a virgin female *Methoca*, bred in confinement, and never in contact with a male, five cocoons of *Methoca* have been procured. It seems, therefore, that the scarcity of the males of *Methoca ichneumonides* is due, at least in part, to the fact that the female is capable of parthenogenetic reproduction.

Whether male or female *Methocae* will emerge from the five cocoons cannot yet be told. A small opening was made in one of the cocoons late in October, and the inmate was found to be still a larva.

That the observations were made on one female only was due to the lack of other individuals concerning the virginity of which it was possible to be certain. It is hoped to make further experiments later and, should enough material be available, to get some cytological results.

My thanks are due to Dr. Hugh Scott, of the University Museum of Zoology, Cambridge, for much kind help and assistance in the arrangement of this paper.

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XXVII. *On Walker's Types of Plume-moths in the National Collection: Redescriptions and Notes.* By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S., Imperial Entomologist to the Government of India.

[Read December 2nd, 1925.]

With Twenty-three Text-figures.

In the 'fifties and 'sixties of the past century, the specimens of moths in the National Collection were described by Francis Walker in the "List of the Specimens of Lepidopterous Insects in the Collection of the British Museum," a catalogue which appeared in 35 parts and which has been wittily described as "the most used and most abused" of all Walker's publications. Abused or not, there is no doubt of the importance of this catalogue, as it included every moth known at that time, and in the case of new, or presumably new, species such were duly described and the descriptions here published, so the list becomes our authority for the nomenclature of a very large percentage of exotic species. The trouble is that, although the species were duly "described" in accordance with the strict letter of the law governing nomenclature, the descriptions are in nearly every case so hopelessly bad that every lepidopterist who has tried to use them has had to confess himself beaten as regards their application.

Those workers who have been fortunate enough to obtain access to the actual type-specimens have been able to see what Walker actually had under his eyes and what he meant by his otherwise meaningless verbiage; those who have not been so lucky have had to remain in the dark as regards his genera and species.

The present paper is a revision of the species of Alucitidae (Pterophoridae) and Orneodidae established as new by Walker in his catalogue. The work has been based on actual examination of his original specimens, so far as they are extant, with redescriptions of his actual type-specimens. It is hoped that the publication of these notes, made from Walker's types, will be of use to those workers who cannot consult the National Collection, both at the present time and in the future.

The references are to Part XXX (published in 1864) of the catalogue except where otherwise indicated.

These descriptions and notes were made by me when last in England in 1909, when I was indebted to the Museum authorities for permission to revise this part of the collection.

9. Agdistes pustulalis Wlk.

Wlk., Cat. Lep. B.M., **30**, 927–8 (1864)—*a–c*, Cape (*Dregé*); *d–f*, South Africa (*Smith*).

Walker's six specimens are still in the collection. The largest of these has since been marked "Type." All six are in very poor condition.

Description of the Type.—♂. Expanse 22 mm. Fore-wing with costa slightly arched, termen rounded, apex not falcate: rather dark fuscous, the usual cuneiform patch little marked but distinctly more thinly scaled; a blackish patch in disc at $\frac{1}{4}$, surrounding base of cuneiform area, and a slight suffusion of blackish scales between this patch and base and between patch and dorsum; an ill-defined aggregation of black scales (hardly forming a dot) near dorsum a little before $\frac{1}{2}$ (on edge of cuneiform mark) and a similar but rather larger one beyond it at about $\frac{3}{4}$ (also on edge of cuneiform shade and near dorsum); costal edge of cuneiform mark indistinctly bordered with a few minute black scales; extreme apex with a slight suffusion of minute black scales. Cilia dark fuscous, paler basally; terminal cilia with a wisp of black scales (? dirt) at extremity of vein 4.

Hind-wing fuscous: cilia fuscous, paler basally: lower surface of disc with a flap of fuscous scales from below vein 7 covering basal part of cell.

13. Platyptilus argyriodactylus Wlk.

Wlk., Cat. Lep. B.M., **30**, 929–30 (1864)—*a–c*, Ceylon (*Templeton*).

The collection still contains two of Walker's original specimens, of which one is labelled "Type" and "Ceylon. 52/62." The Register merely states that the specimens bearing this number were "presented and collected by Mr. Templeton." This is quite an ordinary specimen, considering its age, of the species figured by Lord Walsingham in Ent. Mo. Mag., 1885, 175; the wings on the right side are well spread out and the four lobes of the fore-wing are separate and distinct, so it seems almost incredible that Walker should not have remarked on this peculiarity.

A second specimen is unlabelled and consists of the fore-wings and thorax only. It is probably also one of Dr. Templeton's specimens, as its style of pinning is the same as that of the type.

Walker's third specimen has disappeared. The third individual in the collection is a modern example presented by Col. Yerbury.

14. **Platyptilus emissalis** Wlk. [Fig. 1.]

Wlk., Cat. Lep. B.M., **30**, 930 (1864)—*a*, Sydney (*Lambert*).

[Var. β, Wlk., Cat. Lep. B.M., **30**, 930 (1864)—*b*, Sydney (*Lambert*)—vide *omissalis* sp. n., p. 607.]

Walker's two specimens *a* and *b* are still existent and are both labelled "47/73"; reference to this number in

Fig. 1.—*Platyptilus emissalis* Wlk. Type. Side-view of head.

the Register shows that they were obtained at Sydney by Lambert from whom they were purchased through Argent.

The specimen which Walker calls "Var. β" has fore-wing with second blackish streak obsolete.

There is a third specimen in the series labelled "Moreton Bay. 57 1," from Diggles' collection, which is apparently not referred to by Walker. It is the same as the true type of *emissalis* Wlk.

Meyrick's *emissalis* (Trans. Ent. Soc., 1885, 423) is not *emissalis* Wlk., but *emissalis* var. β, Wlk.

Description of Type-specimen of emissalis Walk.— Expanse 18 mm. ♀ Sex; Walker notes it as a male and it probably is so, as the frenulum is single and large, but the abdomen is now missing. Palpi projecting about half length of head beyond it when viewed from above, upturned, rather slender, joints distinct, terminal joint very small and filiform; pale fuscous. Head fuscous intermixed with whitish; no frontal prominence (very scaleless). Antennae broken. Legs broken, except fore-legs which are pale fuscous with the tarsi blackish.

Fore-wing rather narrow, costa slightly arched, exterior half of

dorsum markedly concave, cleft from $\frac{2}{3}$; first segment slightly dilated posteriorly, apex roundedly subfalcate, termen concave; second segment dilated posteriorly (subcuneate), termen sinuate, being distinctly concave between terminations of veins 4 and 3 and of 3 and 2, anal angle distinct: whitish, thickly irrorated with reddish-fuscous with a few minute black scales intermixed: basal, costal and dorsal areas of wing more strongly suffused with dark fuscous, the remaining area appearing almost greyish to the naked eye; an indistinct subdorsal suffusion of blackish scales at $\frac{1}{5}$; a conspicuous but ill-defined blackish dot in disc at $\frac{1}{3}$; a conspicuous but ill-defined costal triangle at $\frac{2}{3}$, its apex bordering cleft and reaching to base of second segment; the posterior edge of this triangle runs into the costal margin of the first segment as a narrow blackish edging broadening exteriorly but not reaching apex; this black margin is cut at about $\frac{3}{4}$ of length of segment by a narrow white sinuate line which runs transversely across from costa to posterior margin parallel to termen; a small narrow black cuneate mark lies in the outer and dorsal part of this segment, its apex directed towards the base of the wing, its base lying on the transverse white line; second segment slightly suffused with fuscous along dorsum and cut at $\frac{2}{3}$ by a narrow white line running very obliquely inwards. Cilia dark fuscous on costa, white at exterior edge of costal triangle and between transverse white line (across first lobe) and apex; narrowly blackish at apex of wing; on termen whitish with a strong black line; at tornus pale fuscous, black basally; within cleft whitish, black just before termen on posterior margin of first segment and at apex of second segment; on dorsum greyish with a slight black scale-tuft at tornus, two still smaller ones at a little beyond $\frac{1}{2}$ and at $\frac{2}{3}$ and a few scattered blackish scales.

Hind-wing cleft from about $\frac{1}{3}$ and from near base; first segment posteriorly dilated, long-spoon-shaped, apex rather blunt; second segment subparallel, exterior third of hind margin subconcave; third segment linear: fuscous, third segment with a few scattered black scales. Cilia pale fuscous; apex of first segment with black basal scales continued along termen; one or two black basal scales at apex of second segment; dorsum of third segment with a few scattered black scales not forming a tuft.

In the second specimen (Syntype) the scales on dorsum of third segment of hind-wing form a small subterminal tuft.

15. **Platyptilus falcatalis** Wlk. [Fig. 2.]

Wlk., Cat. Lep. B.M., **30**, 931 (1864)—*a–d*, Auckland, New Zealand (*Oxley*).

Four specimens labelled "60/73"; the Register gives these as collected by Oxley at Auckland, N.Z. The one now marked type is a ♂. Meyrick's description is pretty accurate.

Comparison of falcatalis and repletalis.—In *repletalis* the 2nd + 3rd joints of palpus extend beyond tip of frontal prominence for half their combined length; in *falcatalis* the 2nd + 3rd joints of palpus extend beyond frontal prominence for a distance less than half their combined length: *falcatalis* is generally a brighter, redder, larger and more sharp-winged insect, with the costal triangle

Fig. 2.—*Platyptilus falcatalis* Wlk. Type. Side-view of head.

very distinct and the space beyond it bright yellowish; *repletalis* is small, broader-winged, duller, the costal triangle often indistinct and space beyond it often scarcely lighter, certainly not conspicuously so.

One labelled "54/4" (Auckland; Col. Bolton) is apparently one of Walker's original *repletalis*, but is in very poor state. Two other examples seem to be *falcatalis*; one is labelled "45/61" (= "New Zealand, presented by Dr. A. Sinclair, R.N."), the other, labelled "47/104" (= "New Zealand; presented by Dr. Andrew Sinclair, R.N.; Auckland").

Description of Type falcatalis Wlk.—♂. Expanse 23 mm. Palpi porrect, ascending; second joint long, dilated terminally, not quite reaching extremity of frontal prominence; third joint short, filiform, acuminate: fuscous, intermixed with reddish-brown. Head greyish; frontal prominence sharp, beak-like, barely equal in length to breadth of eye. Antennae dark fuscous, basal joint greyish. Haustellum well developed, red-brown. Abdomen long, slender, scarcely as long as dorsum of fore-wing, fuscous sprinkled

along sides with a few blackish scales; anal tufts pale fuscous, one short central one over genitalia and a pair of short divergent tufts extending slightly beyond apex of abdomen.

Fore-leg long, slender, reddish-fuscous to extremity of tibia which is conspicuously dilated with scales; first three tarsal joints pale greyish-white broadly banded terminally with dark red-brown; last two tarsal joints dark reddish-fuscous. Mid-leg long, slender, reddish-fuscous to tip of femur; tibia pale whitish grey, with a central dark reddish-fuscous band which emits a few hair-like scales of similar colour, apex dilated with dark reddish-fuscous scales and emitting a pair of subequal spurs, which are dark red-brown basally and apically, grey-white centrally; tarsi as in fore-leg. Hind-leg reddish-fuscous to tips of tibiae; inner spurs (both proximal and distal) longer than outer; tarsi broadly banded terminally with reddish-fuscous, two terminal joints reddish-fuscous.

Fore-wing long, narrow, costa nearly straight, apex falcate, cleft from about $\frac{3}{4}$, termen of first lobe slightly concave beneath produced apex, of second lobe sinuate: whitish, thickly sprinkled with reddish-fuscous especially along costa, small ill-defined accumulations of dark reddish-fuscous scales along dorsum at $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{2}{3}$, and on costa at $\frac{2}{5}$; a blackish costal triangle at $\frac{3}{4}$, its apex extending into wing to a little below base of cleft from which it is separated by a small patch of whitish scales. First segment cut at $\frac{3}{4}$ of its length by a narrow yellowish-white line extending obliquely inwards from costa to its hinder margin, roughly parallel to termen; the space between this white line and costal triangle suffused with yellowish; hinder margin of lobe black between extremity of white line and base of lobe; a narrow cuneate black mark in lower half of lobe, its base resting on the white transverse line, its apex towards base of wing. Second segment suffused with blackish-fuscous towards base and along dorsum; otherwise yellowish-fuscous, overlaid with scattered whitish scales which form a small patch at apex and a larger patch in middle of anterior margin. Cilia black on costa except beyond costal triangle and beyond transverse white line, where they are whitish; on termen fuscous, with darker patches on apex and tornus; within cleft whitish, a dark fuscous preterminal patch on hinder margin of first lobe and a dark fuscous patch at apex of second lobe. [The hind-wing being folded under fore-wing no further details can be seen in this specimen. The description is now continued from another and similar specimen (also labelled "60/73").] Cilia of fore-wing fuscous around tornus, on dorsum whitish with a small black scale-tooth at $\frac{5}{6}$ (below base of cleft) and a larger one at $\frac{2}{3}$, with a few scattered black scales between this and $\frac{1}{2}$.

Hind-wing cleft from about half and from near base; first segment elongate-spatulate; second segment posteriorly dilated, tornus well marked, termen very slightly concave; third segment with tornus scarcely evident; pale reddish-fuscous. Cilia fuscous; dorsum of third segment with an elongate tooth of black scales a little beyond half and a few scattered black scales along remainder of dorsum.

16. **Platyptilus repletalis** Wlk. [Fig. 3.]

Wlk., Cat. Lep. B.M., **30**, 931 (1864)—*a–g*, New Zealand (*a–e, Bolton*; *f–g, Sinclair*).

Five specimens (Walker's *a–e*) labelled "54/4" (= "collected at Auckland, N.Z., and presented by Col. Bolton"). There are really six labelled "54/4," but one of these is *falcatalis*, as are Walker's other two specimens labelled "45/61" and "47/104."

Fig. 3.—*Platyptilus repletalis* Wlk. Type. Side-view of head.

In the collection are also two *repletalis* from the Stainton collection labelled "Canterbury, N.Z.; Fereday; 1866."

Type-specimen of repletalis Wlk.—♀. Expanse 20 mm. Palpi porrect, fuscous, rather lighter above, dotted on exterior sides with dark reddish-fuscous; second joint long, thickly clothed, projecting nearly half its own length beyond frontal prominence; third joint short, filiform. Head pale fuscous, dotted with darker; a frontal cone of scales, the distance from margin of eye to apex of cone subequal to diameter of eye. Antennae dark fuscous, shortly ciliated. Thorax fuscous, sprinkled with reddish-brown and darker, especially on metathorax. Abdomen long, slender, slightly longer than from base of fore-wing to base of cleft, fuscous sprinkled with reddish-brown, darker apically where also the incisions of the segments are marked with blackish; sides and venter sprinkled with patches of red-brown and black.

Fore-leg whitish fuscous, thickly sprinkled and striped with red-brown, extremity of tibia dilated with a strong red-brown scale-tuft tipped with whitish, tarsi broadly banded with red-brown apically. Mid-leg dark reddish-fuscous sparsely sprinkled with whitish; tibia with a median dilatation of red-brown scales tipped with whitish, tibia banded with whitish beyond this, and with a

similar apical dilatation emitting two moderate subequal spurs, pale fuscous tipped with blackish; tarsi whitish-fuscous broadly banded apically with dark reddish-fuscous. Posterior legs wanting.

Fore-wing rather broad, costa nearly straight, apex rather rounded, termen of first segment falcate but gently curved, posterior angle of first segment well marked, cleft to about $\frac{3}{4}$, second segment with termen gently sinuate and angles well marked, dorsum nearly straight on basal half, strongly curved posteriorly on exterior fourth. Colour pale whitish-fuscous, thickly sprinkled with red-brown and dark reddish-fuscous, this sprinkling tending to accumulate on the basal two-thirds as outwardly oblique spots of the latter colour along the costa and as inwardly-oblique strigulae of the former colour on the dorsal half of the wing; to the naked eye this gives the wing a rather mottled ligneous appearance. A longitudinal subcostal black spot at $\frac{1}{3}$, an accumulation of dark reddish-fuscous scales on costa at $\frac{2}{3}$ forming a small costal triangle prolonged downwards towards but not reaching base of cleft and sprinkled with a few whitish scales, and a short transverse black striga before and rather below base of cleft. First segment yellowish white at base, sparsely sprinkled with red-brown, exterior half of costa margined with red-brown with a few whitish scales intermixed, exterior posterior fourth of segment grey-white, with a few red-brown scales intermixed, preceded by a cuneiform patch of red-brown, its apex basad. Second segment dark red-brown, lighter basally, crossed at $\frac{1}{8}$ and $\frac{1}{2}$ by a very narrow undulate whitish line and at $\frac{2}{3}$ by a narrow sinuate yellowish-white line, exterior third sprinkled with whitish, more so towards costa.

Cilia at apex red-brown, on termen of first segment light fuscous with a blackish basal line, within cleft light fuscous mixed with blackish; on termen of second segment light fuscous, at base reddish-fuscous tipped with black except in middle of termen where the long light-fuscous cilia extend into the margin of the wing forming a curious and characteristic gap-like mark; on dorsum light fuscous, with a few scattered black scales, a moderate black scale-tooth at $\frac{2}{3}$, exterior fourth intermixed with blackish.

Hind-wing cleft from about $\frac{1}{2}$ and from near base, first segment elongate-spatulate, second segment triangular with sharp angles, third segment sublinear, tornus scarcely evident; fuscous: cilia fuscous, blackish basally on termen of first segment, and on second segment from around apex to around tornus, dorsal cilia of third segment with a few scattered black scales and a small scale-tooth at $\frac{1}{2}$, this tooth being formed apparently of scales black at their *tips* only.

The points on which I should rely for separation of *falcatalis* and *repletalis* are the differences in length of palpi, and the paler space at base of cilia of second segment of the fore-wing found in *repletalis* and not in *falcatalis*. This pale cilial space is also absent in *emissalis* Wlk., *omissalis* (*emissalis* Meyr.), *littoralis* Butl., *rhynchophora* Meyr.

One of Stainton's Canterbury specimens is much greyer, and the wings look more falcate. The costal triangle is very evident and is followed by a pale yellowish space. The whole insect looks much like a small *falcatalis*, but the palpi are long as in *repletalis*.

Platyptilia omissalis n. s. [Fig. 4.]

Platyptilus emissalis var. β, Wlk., Cat. Lep. B.M. XXX. 930 (1864)—*b*, Sydney (*Lambert*).

Fig. 4.—*Platyptilia omissalis* n. sp. (= *emissalis*, var. *β*, Wlk.) Type. Side-view of head.

Platyptilia emissalis Meyr. (*nec* Wlk.), Trans. Ent. Soc., 1885, 423.

Besides Meyrick's description I should add :—

(i) A minute blackish-fuscous scale-tooth in dorsal cilia of fore-wing at about $\frac{5}{8}$ of dorsum directly beneath base of cleft.

(ii) Frontal prominence short, sharply pointed, from margin of eye to apex of tuft about $\frac{2}{3}$ diameter of eye.

(iii) Palpi long, second joint triangularly dilated with scales, longer than diameter of eye; third joint hidden in scales of second.

The B.M. specimen is labelled " 47/73 " (— " New Holland, Sydney. Purchased of Lambert through Argent ").

13. **Oxyptilus pusillidactylus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 933 (1864)—*a*, Jamaica (*Gosse*).

One specimen, apparently a ♀, in very bad state, labelled " 45/110 " (the Register gives " Jamaica. Purchased of Gosse ").

Expanse 11 mm. (rough estimate, as wings are not straight). Head, thorax and abdomen too mouldy, dirty and scaleless to make out any details. Posterior leg greyish thickly irrorated with dark fuscous; tibial spurs long, subequal (outer proximal spur broken off), dark fuscous with a lighter band at about $\frac{2}{3}$ and pale tips.

Fore-wing: costa slightly arched, apex strongly produced and falcate; cleft to $\frac{2}{3}$, fissure broad and conspicuous; termen of first segment concave, of second sinuate; anterior margin of second segment concave; dorsum nearly straight. Colour pale reddish-fuscous minutely irrorated with darker: costa dark reddish-fuscous; a very indistinct dark reddish-fuscous dot on dorsum at $\frac{1}{4}$ and below costa at $\frac{1}{3}$; a blackish-fuscous costal triangle, its anterior edge ill-defined, straight, running obliquely outwards, its posterior edge well-defined running obliquely inwards, concave, its apex reaching base of second segment but separated from cleft: first segment blackish-fuscous cut at $\frac{3}{4}$ by a narrow white line running obliquely inwards from costa to hinder margin; traces of a short oblique white line running from apex to transverse white line; tornal area beyond white line pale yellowish: second segment pale reddish-fuscous, medial third blackish-fuscous preceded and followed by a sinuate white line, the outer line the more distinct and margined posteriorly on dorsal half with a few black scales. Cilia on costa blackish-fuscous, narrowly whitish beyond costal triangle, reddish-fuscous before apex; whitish on termen of first segment with a blackish basal line broader around its posterior angle; within cleft whitish; on second segment black at base at anterior angle, on termen whitish, black at base below anterior angle, in centre and near tornus, the base of cilia thus being whitish between terminations of veins 4 and 3 and 3 and 2; on dorsum whitish, with moderate black scale-teeth at $\frac{3}{5}$ and $\frac{4}{5}$ and a few blackish-fuscous hair-scales towards tornus.

Hind-wing cleft from about $\frac{1}{2}$ and from base; first segment elongate-spatulate, scarcely dilated posteriorly; second segment elongate, posteriorly triangular (both these segments difficult to make out); third segment linear: fuscous, third segment sprinkled with darker: cilia rather paler fuscous; a few blackish scales around apex of first segment and beneath apex of second, third segment (in very bad state) with a strong black scale-tooth at about $\frac{2}{3}$ and extending to apex.

This seems in all respects similar to the common Indian *Lantana*-feeding Plume (= *hemimetra* Meyr.).

14. **Oxyptilus nanellus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 933 (1864)—*a*, Ega (*Bates*).

It is labelled "58 6" (= "Ega on the Amazon; purchased from Stevens").

? ♀. Expanse 11 mm. Palpi short, drooping, yellowish-white, third joint filiform, nearly as long as second. Haustellum developed. Antennae yellowish-grey, finely ciliated. Fore-leg whitish, upperside of femur spotted with blackish, tibia short and dilated apically with a scale-tuft dotted with blackish; mid-leg whitish, with long equal spurs, black spotted at base, on apex of tibia; hind-leg broken. (Possibly the leg described as mid may be hind, but I cannot see its origin.)

Fore-wing narrow, cleft to about $\frac{1}{2}$, first segment linear, second almost linear, but slightly dilated at tornus and with termen very oblique, tornal angle scarcely noticeable: colour very pale yellowish-white, on outer half of segments pale ochreous; a blackish mark at base of cleft. Cilia grey-whitish; on costa a black scale at $\frac{3}{5}$ of first segment and at apex; two minute black scale-tufts on posterior margin of first segment, one at about $\frac{1}{2}$ length of segment, the other subapical; anterior margin of second segment with a black scale at about $\frac{1}{5}$ of its length and a minute black scale-tuft at $\frac{1}{2}$ and a small fuscous-ochreous preapical scale-tooth; on dorsum whitish, very long between $\frac{1}{2}$ of wing-length and tornus.

Hind-wing cleft from $\frac{2}{5}$ and from base; segments linear; very pale yellowish-white: cilia long, grey-whitish, a few strong black scales on exterior third of anterior margin of third segment and apparently a small but strong preapical black scale-tooth on dorsum.

Thorax and abdomen almost scaleless, apparently pale yellowish originally.

This seems almost intermediate between *Oxyptilus* and *Trichoptilus*.

17. **Oxyptilus direptalis** Wlk. [Fig. 5.]

Wlk., Cat. Lep. B.M., **30**, 934 (1864)—*a*, Cape (*Dregé*).

[Var. ? Wlk., Cat. Lep. B.M., **30**, 934 (1864)—*b*, Congo (*Richardson*).]

Walker's specimen *b* is labelled "43/56"; reference to the Register shows that this was collected by Dr. Andrew Curror, R.N., H.M.S. *Waterwitch*, in the "Congo" region. It is a quite ordinary example of *Sphenarches caffer* Z.; Walker notes that it "may be a distinct species" (!).

Walker's specimen *a* is labelled "42/77" (="purchased from Dregé of Hamburg; from Cape of Good Hope").

Another specimen (apparently *Exelastis liophanes* and also labelled "42/77") was also figuring in the series of *direptalis*; I have removed it, as it was not one of Walker's specimens.

Type-specimen of direptalis Wlk.—? Sex. Expanse 17 mm. Palpi, antennae, legs and abdomen broken. Head and thorax (very scaleless) greyish, sprinkled with red-brown.

Fore-wing greyish-fuscous thickly sprinkled with dark fuscous and dark reddish-brown; a blackish-fuscous costal triangle at $\frac{2}{3}$, its apex just reaching into base of second segment but not touching base of fissure; exterior edge of costal triangle sharply bounded by a paler area at base of first segment, yellowish-white on costa

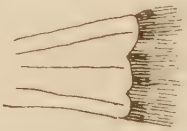

Fig. 5.—*Oxyptilus direptalis* Wlk. Type. Cilial tufts on second segment of fore-wing.

irrorated with reddish-fuscous towards hinder margin; median third of segment blackish-fuscous, sharply edged exteriorly by a yellowish-white line running from costa to hinder margin parallel to termen; area beyond this white line greyish, margined anteriorly with red-brown. Second segment blackish-fuscous except towards base and around anterior angle, cut at two-thirds by a white line running from anterior margin to dorsum and parallel to termen. Cilia on costa blackish-fuscous, paler towards base, whitish between costal triangle and median dark bar on first segment, on termen fuscous black basally, within cleft dark grey with blackish ante-apical wisps on hinder margin of first segment and fore margin of second segment, on termen of second segment fuscous (the long hairs), blackish basally around terminations of veins 4, 3 and 2, on dorsum fuscous with a long posteriorly-concave black scale-tooth at about $\frac{3}{5}$ and a smaller black scale-tooth at about $\frac{1}{5}$ (beyond base of cleft).

Hind-wing cleft from about $\frac{1}{2}$ and $\frac{1}{6}$; first segment gradually widened exteriorly, apex rather rounded, spatulate; second segment scarcely widened exteriorly; tornus well marked, termen slightly concave; third segment almost obsolete, tornus not per-

ceptible; fuscous: a few blackish scales on apex of first segment, dorsum of third segment with a moderate basal scale-tooth at about $\frac{2}{3}$ and a few black scales scattered between this and base of wing.

[I cannot follow Meyrick's remarks on the differences between *direptalis* and *cosmodactyla* (*acanthodactyla*) as regards colour and scale-tufts. The latter seem identical. There is a slight difference which may be tabulated as :—

Second segment of hind-wing distinctly broadened exteriorly (nearly twice as broad at tornus as at base).	*cosmodactyla*.
Second segment of hind-wing scarcely broadened exteriorly (not $\frac{3}{4}$ as broad at tornus as at base.	*direptalis*.]

Besides the type there are two other specimens of *direptalis* :—

(*b*) Natal—Stainton Coll.

(*c*) Assam, Shillong, Sep. 1893. 1908 122 (presented by Rothschild. Named by Meyrick.

18. **Oxyptilus anisodactylus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 934-5 (1864)—*a*-*b*, Ceylon (*Nietner*).

Three specimens in B.M. collection, all labelled "57/48"; "captured at Colombo in December by Mr. Nietner." Of these three one is *Trichoptilus pelias* (to which I have removed it), the other two are ordinary *Sphenarches caffer*. As this species has been described several times already and figured ("Ind. Mus. Notes," II, 20), I think it unnecessary to enter into a full description of these specimens.

Walker's description is fairly correct so far as it goes, but the hind-tibiae are reddish-brown, and not "blackish" about the base of the spurs.

19. **Oxyptilus idonealis** Wlk. [Fig. 6.]

Wlk., Cat. Lep. B.M., **30**, 935 (1864)—Sarawak, Borneo (*Saunders' Coll.*, B.M., 1894).

The single type-specimen labelled "Sar." It is in very poor state, five legs, the left fore-wing and abdomen being totally missing, and the thorax has been broken in two at some time and gummed together again with the attached hind-wings. The specimen is also very worn and rubbed and is unset.

Expanse 17 mm. (double length from pin to apex of right fore-wing). ? Sex. Palpi long, slender, ascending, third joint directed upwards and forwards, acuminate, shorter than second; greyish, banded with fuscous. Head and antennae yellowish-greyish fuscous, the latter finely ciliated. Thorax broken. Fore-leg greyish lined and irrorated with fuscous.

Fore-wing long, slender, cleft to $\frac{1}{2}$, first segment linear, second segment sublinear, tornus inconspicuous, termen subparallel to dorsum. Colour light fuscous, thickly irrorated with dark fuscous; a blackish-fuscous outwardly-oblique costal spot at $\frac{1}{3}$; a narrow transverse whitish bar from base of first segment across base of fissure; basal half of first segment rather lighter, terminal half dark fuscous; first segment cut transversely at $\frac{1}{2}$ by a whitish

Fig. 6.—*Oxyptilus idonealis* Wlk. Type. Side-view of head.

bar and at $\frac{3}{4}$ of its length by a narrow white line; second segment suffused with whitish at $\frac{1}{2}$ of its length: cilia on costa dark fuscous, whitish opposite white markings; elsewhere fuscous, on hinder margin of first segment with some black scales on basal third (apparently remains of a small tooth at $\frac{1}{4}$) and about $\frac{3}{4}$ (also apparently remains of a small tooth), on fore margin of second segment a few scattered black scales principally evident at about $\frac{1}{4}$, $\frac{5}{12}$, $\frac{2}{3}$ and $\frac{5}{6}$ of its length, on dorsum with a small black scale-tooth at $\frac{2}{3}$ and a few scattered black scales before tornus.

Hind-wing cleft from about $\frac{1}{3}$ and from near base, segments linear; fuscous, irrorated with darker: cilia fuscous; a black scale beneath apex of second segment and scattered black scales on hinder margin of second segment at about $\frac{2}{3}$ and $\frac{3}{4}$ (only visible on one wing, possibly detached from elsewhere and caught by the long cilial hairs); fore margin of third segment with a small black preapical scale-tooth, dorsum with a moderate black tooth at about $\frac{3}{4}$, a couple of subapical black scales, and three minute black scale-teeth between $\frac{1}{2}$ and $\frac{3}{4}$, of which the outermost is the largest.

20. **Oxyptilus cinctipedalis** Wlk.

Wlk., Cat. Lep. B.M., **30**, 935 (1864)—*a*, Moreton Bay (*Diggles*).

Two specimens, of which only one was in the Museum

in Walker's time. It is labelled "57/1" (= "collected by Mr. Diggles at Moreton Bay and Sydney, Australia").

♀. Expanse 9 mm. Palpi porrect, filiform, third joint shorter than second; light fuscous, banded with blackish. (Antennae broken.) Head rather yellowish-fuscous. Thorax fuscous lightly and minutely sprinkled with darker, posteriorly lighter. Abdomen reddish-fuscous minutely sprinkled with whitish and darker with obscure transverse dorsal whitish bars at base and at $\frac{1}{2}$, a short subdorsal blackish longitudinal bar at about $\frac{2}{3}$ margined by lighter. Fore-leg fuscous, irrorated with darker; tibia short, an apical dilatation emitting a minute spine. Mid-leg blackish-fuscous; tibia striated longitudinally with whitish, dilated with scales apically and emitting two equal apical blackish-fuscous spurs banded with whitish in centre; tarsi dark fuscous banded with whitish. Hind-leg dark fuscous irrorated and banded with whitish, tibia dilated with scales at points of emission of the long equal blackish spurs which are banded with whitish above base and again before apex; tarsi dark fuscous whitish-banded apically, the first joint with a median whitish band also.

Fore-wing cleft from a little beyond half, first segment linear, second segment posteriorly slightly dilated, tornus rather rounded, termen oblique subconcave. Colour fuscous, irrorated with blackish-fuscous, especially evident along costa and broadly so before base of cleft as an indistinct costal triangle whose apex reaches into base of second segment; a minute blackish-fuscous dorsal dot at $\frac{1}{6}$; first segment with a very indistinct narrow transverse outwardly-oblique whitish line at about $\frac{1}{3}$, the segment beyond this darker fuscous, a very indistinct narrow transverse whitish line across segment at about $\frac{3}{4}$; second segment blackish-fuscous at base dorsally, remaining area irrorated with white scales tending to form narrow transverse lines. Cilia blackish on costa, but white opposite first transverse whitish line, yellowish opposite second line and greyish subapically; a long narrow black wisp * at apex; on hinder margin of first segment yellowish-fuscous, paler anteriorly, between $\frac{1}{2}$ and $\frac{3}{4}$ blackish, followed by a narrow white bar, two small blackish wisps * not extending beyond base of cilia and a whitish subapical wisp *; on fore margin of second segment yellowish-fuscous, darker on posterior half; at apex of second segment yellowish-fuscous with a rounded black tuft at base; on termen yellowish-fuscous, dark fuscous at base; on dorsum blackish with a broad yellowish-fuscous wisp beyond $\frac{3}{4}$.

* I have used the term "wisp" to indicate a patch of cilial *hairs* as opposed to a tuft or tooth of cilial *scales* (usually basal).

Hind-wing cleft from ¼ and from base; segments linear; fuscous, irrorated with dark fuscous. Cilia blackish-fuscous, yellowish-fuscous before apex on hinder margins of first and second segments, third segment with a few scattered blackish-fuscous scales at and around apex and a small blackish subapical scale-tooth on dorsum.

A second specimen (Moreton Bay—Stainton Coll.) is very similar, but has a longitudinal blackish dot in disc at ⅓, and the white transverse lines on the first segment of the fore-wing are more distinct. The ground-colour is also rather lighter—more of a pale reddish-fuscous.

40. **Pterophorus petrodactylus** Wlk. [Fig. 7.]

Wlk., Cat. Lep. B.M., **30**, 940–1 (1864)—*a*, Arctic America (*Richardson*).

Fig. 7.—*Pterophorus petrodactylus* Wlk. Type. Side-view of head.

One specimen, Walker's type, labelled "51.150" (= "from coast of Arctic N. America between 67½ and 68°; presented by Sir John Richardson"). This locality is apparently in Baffin Land. Walker's description evidently belongs to this specimen, although Lord Walsingham states that he is "utterly unable to reconcile it" (*Pter. Cal.*, p. 20). The figure (t. 2, f. 15, *l.c.*) is not very good, being too uniformly coloured—rather wishy-washy.

This seems to be a *Stenoptilia* rather than a *Platyptilia*.

♂. Expanse 24 mm. (Lord Walsingham gives 23; it is difficult to measure as both wings slant down at an angle). Palpi porrect, ascending, rather short, thickly clothed, third joint shorter than second, fuscous irrorated with darker. Antenna fuscous, very minutely ciliated. Head pale yellowish-fuscous; frontal cone very slight. Thorax scaleless. Abdomen moderately long (slightly longer than from base of wing to base of cleft), slender, fuscous with a few whitish scales intermixed and thickly irrorated with blackish; anal tuft rather short, inconspicuous, fuscous. Fore-leg fuscous, spotted and streaked with blackish, tibia dilated apically with a tuft of fuscous hair-scales. (Mid-legs broken.) Hind-leg long, slender, fuscous with a very few white scales inter-

mixed; tibia approximately equal to abdomen in length; tibial spurs at $\frac{2}{3}$ and apex; outer proximal spur broken; inner proximal spur about $\frac{3}{4}$ length of equal distal spurs; tibia very slightly dilated with scales at apex; tarsi long, slender, joints scarcely perceptible.

Fore-wing rather broad, cleft from about $\frac{3}{4}$; first segment broadened exteriorly, apex acute subfalcate, termen nearly straight, hinder angle rounded; second segment broadened posteriorly, anterior angle acute, termen nearly straight, tornal angle well marked. Colour pale whitish: costal area from base to $\frac{3}{4}$ broadly fuscous minutely irrorated with pale grey; dorsal region thickly irrorated with fuscous throughout to termen; discal region irrorated with fuscous and greyish from base of wing to base of cleft; a series of very minute blackish lines transversely across central third of wing shortly before base of cleft: first segment very pale yellowish-white, an inwardly-oblique slightly-curved cuneate blackish-fuscous bar from costa before apex towards base of cleft but not reaching margin of cleft, subterminal area fuscous: second segment pale whitish minutely irrorated with fuscous, a short longitudinal blackish-fuscous subdorsal bar at base of segment, subterminal area fuscous. Cilia on costa blackish, blackish-fuscous towards apex; on termen of first segment white, fuscous at base; on hind margin of first segment white, with a broad fuscous wisp at posterior angle; on fore margin of second segment white with a broad fuscous wisp at anterior angle; on termen of second segment white, fuscous at base; at tornal angle fuscous with a few blackish scales; on dorsum white narrowly tipped with fuscous.

Hind-wing cleft from about $\frac{1}{2}$ and $\frac{1}{6}$; first segment regularly dilated, apex rounded; second segment triangularly dilated, hinder angle distinct, termen subconcave; third segment sublinear, tornal angle indistinct: pale fuscous irrorated with fuscous. Cilia greyish-fuscous; on costa fuscous before apex; rather darker beneath apex of first and second segments; on dorsum greyish-fuscous, whitish at base of cilia throughout length of segment.

41. **Pterophorus homodactylus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 941 (1864) *a*, United States (*E. Doubleday*).

One specimen labelled "U.S.A. 44/1." Walker says this was "presented by E. Doubleday"; the Register shows it as "purchased of Mr. Dyson."

♂. Expanse 23 mm. Palpi porrect, straight, short, threadlike, third joint very sharp and pointed; very pale yellowish-white.

Antennae whitish, ciliated (about $\frac{1}{2}$); basal joint enlarged with a short hair-tuft on inner lower margin. Head whitish anteriorly, pale fuscous posteriorly. Thorax and abdomen whitish, the latter long and slender nearly equalling in length from base of wing to apex of second segment. Fore-leg whitish, tibia slightly dilated apically, tarsi long and slender. Mid-leg whitish; a pair of spurs on apex of tibia, the inner spur longer than outer. Hind-leg long, slender, whitish; tibial spurs subequal; tibia not dilated.

Fore-wing long, narrow, cleft from about $\frac{2}{5}$; costa arched; first segment sharp-pointed, anal angle obsolete; second segment sharp-pointed, anal angle rounded and inappreciable. Colour whitish thinly irrorated with minute scales of dark fuscous and with a very slight yellowish tinge along costal region; apical region slightly suffused with fuscous; an indistinct fuscous longitudinal mark at base of cleft. Cilia whitish.

Hind-wing cleft from about $\frac{1}{3}$ and $\frac{1}{6}$; first segment slightly enlarged exteriorly, second segment lanceolate, third segment linear; whitish; a longitudinal posteriorly-curved row of minute black scales along posterior portion of cell on lower surface of wing. Cilia whitish.

This specimen is in poor condition—worn and rubbed.

42. **Pterophorus agraphodactylus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 941 (1864)—*a*, St. Domingo (*Tweedie*).

A single specimen in B.M. collection, Walker's type, labelled "St. Dom. 55,1" (= "St. Domingo; purchased from Stevens; collected by Mr. Tweedie").

Walker says that it is a ♀; the abdomen is now broken and I cannot see any frenulum; probably it is ♀. The specimen looks as if it had faded a good deal since Walker's time.

Expanse about 21 mm. (apex of right fore-wing broken and allowed for). Palpi short, down-curved, filiform; third joint shorter than second, acuminate; very pale yellowish-whitish. Antennae very pale yellowish-whitish, basal joint enlarged and clothed with scales. Head and thorax pale yellowish-whitish. Fore-leg pale yellowish-white, irrorated with dark fuscous as far as middle of tibia whose apex is slightly dilated with scales. (Other legs broken.)

Fore-wing cleft from about $\frac{2}{3}$, rather narrow, moderately and regularly dilated exteriorly; first segment parallel-sided on its basal half, apex finely-pointed; second segment parallel-sided,

tornus rounded and angle not evident: colour very pale yellowish-whitish; the whole costal region above cell suffused with very pale ferruginous; area within cell and beyond cell to base of cleft irrorated with pale ferruginous except for a narrow streak of ground-colour along vein 4 (submedian); dorsal area irrorated with pale ferruginous especially basally: first segment pale ferruginous, slightly darker apically with a narrow line of pale yellowish-whitish along hinder margin: second segment very pale yellowish-whitish, irrorated with pale ferruginous along fore margin above vein 4 and with vein 3 indicated in pale ferruginous. Cilia greyish-white, with a slight yellowish tinge along dorsum and with a narrow darker wisp at apex.

Hind-wing cleft from about $\frac{1}{3}$ and $\frac{1}{6}$; first segment parallel-sided, apex pointed; second segment with costa nearly straight, very sharp-pointed, posterior angle rounded, terminal region very slightly concave; third segment linear: pale fuscous, thickly irrorated with fuscous: cilia greyish-fuscous.

43. **Pterophorus aspilodactylus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 941-2 (1864)—*a*, Jamaica (*Gosse*).

One specimen (45/110), Walker's type, labelled "45/110" (= "Jamaica; purchased of Gosse").

Expanse 24 mm. This is a very worn and mouldy specimen of the preceding: I do not see any differences.

46. **Pterophorus umbrigeralis** Wlk. [Fig. 8.]

Wlk., Cat. Lep. B.M., **30**, 942 (1864)—*a*, Bogota (*Stevens*).

One specimen, Walker's type, labelled "56/142; Bogota"; the Register gives "selected from the collection of the late Mr. Stevens of Santa Fé da Bogota."

Of Felder's figures it is nearest his *Mimeseoptilus posticus* (from Bogota), of which it may possibly be the ♀; I can hardly reconcile Felder's species, with very pronounced costal triangle, with the genus *Stenoptilia*.

Expanse 24 mm. (The abdomen is broken and Walker does not state any sex; possibly it is a female.) Palpi long, thickly and rather roughly scaled, second joint as long as diameter of eye, third joint short, porrect, projecting about length of head beyond it; chocolate-brown, lightly flecked with black scales. Antennae minutely ciliated; brown, annulated with blackish. Head dark chocolate-brown; a small frontal tuft, its length from base of eye to apex barely half diameter of eye. Thorax dark

chocolate-brown, irrorated with blackish on tegulae. Fore-leg chocolate-brown, striated and flecked with whitish; apex of tibia dilated and emitting a minute blunt spine (? acuminate hair-tuft); first three tarsal joints lined beneath with yellowish-white at base, last four joints roughened beneath with hair-scales. Mid-leg dark chocolate-brown extensively striated and flecked with whitish; extremity of femur dilated with a small tuft of scales; tibia with blackish-chocolate tufts before $\frac{1}{2}$ and at apex, the latter tuft emitting a pair of spurs of which the inner is the longer, tibia longitudinally striated above with whitish between base and first scale-tuft, banded with whitish for middle third of distance between scale-tufts; tarsi whitish, dark chocolate apically, slightly roughened. Hind-leg long, slender; trochanter whitish broadly barred with blackish-chocolate; femur whitish, slightly flecked with dark chocolate; tibia whitish suffused (especially apically) with dark chocolate, at $\frac{2}{3}$ a pair of spurs white in centre and at apex, of which the inner is the longer, at apex thickened with scales and emitting

Fig. 8.—*Pterophorus umbrigeralis* Wlk. Type. Side-view of head.

a pair of spurs of which the inner is the longer ($\backsimeq 4:3$); tarsi chocolate-brown, with some blackish suffusion apically.

Fore-wing rather narrow, cleft from rather within $\frac{3}{4}$; first segment slightly widened exteriorly, apex scarcely produced, termen concave, posterior angle distinct; second segment regularly widened exteriorly, anterior angle distinct, termen sinuate (retracted between nervures), tornus slightly rounded but distinct: colour chocolate-brown minutely irrorated with whitish scales which form very narrow inwardly-oblique strigulae across wing before cleft; an inwardly oblique bar of blackish suffusion across wing at about $\frac{1}{3}$; a blackish subcostal triangle before cleft, area between base of triangle and costa suffused with blackish, apex of triangle reaching below cleft but separated from it; first segment with some blackish costal suffusion before apex and faint traces of a narrow transverse whitish submarginal line; second segment slightly irrorated with minute whitish scales, small blackish-chocolate markings in middle of termen and at tornus. Cilia dark chocolate on costa and on termen of first segment, within cleft greyish dotted with black and wholly black on outer fourth of segments, on termen of second

segment greyish blackish-fuscous basally, on dorsum whitish with a small black scale-tooth at about $\frac{2}{3}$ preceded and followed by a few scattered black scales and a smaller black scale-tooth at about $\frac{3}{4}$.

Hind-wing cleft from about $\frac{1}{2}$ (?; difficult to see, not properly expanded) and from base; rather dark fuscous irrorated with blackish-fuscous especially on third segment; first segment considerably dilated exteriorly, apex moderately acute; second triangularly dilated, anterior angle acute, posterior angle rounded; third segment sublinear, parallel-sided, tornus obsolete. Cilia fuscous, paler on exterior margins of segments and on dorsum, darker beneath apices of all segments; third segment with some blackish scales basally (*i.e.*, at base of cilia) around apex, on dorsum with a large triangular black scale-tooth extending between $\frac{1}{2}$ and $\frac{3}{4}$ and a few basal (cilial) blackish scales between this and base of wing.

47. **Pterophorus impersonalis** Wlk.

Wlk., Cat. Lep. B.M., 30, 942 (1864)—*a*, Venezuela (*Dyson*).

One specimen, labelled "47/9" (= "Venezuela; purchased from Dyson"). Apparently a ♂, although Walker says it is a ♀. It is in poor condition, very scaleless and with a large hole through cell of each fore-wing.

Expanse 26 mm. Palpi short, filiform; third joint slightly shorter than second, acuminate; dirty whitish. Antennae with enlarged basal joints, slightly ciliated, dirty whitish. Head with a few pale yellowish-grey scales at bases of inner side of antennae (apparently remains of tufts), otherwise scaleless. Thorax scaleless. Abdomen light fuscous, irrorated with dark fuscous; anal tuft fuscous, with a slight yellowish tinge. Fore-leg scaleless; (mid-legs broken); hind-leg pale grey, dark fuscous at junction of femur and tibia, tibial spurs at about $\frac{2}{3}$ and apex, proximal pair very unequal, inner spur about twice length of outer, inner distal spur shorter and stouter than inner proximal, outer distal spur broken, tibia not thickened, tarsi long and slender.

Fore-wing long, narrow, cleft from $\frac{2}{5}$ (not cleft $\frac{2}{3}$ length of wing, as Walker has it); first segment long, slender, parallel-sided, pointed, subfalcate; second segment very slightly widened exteriorly, pointed, tornus rounded and angle obsolete, termen very slightly concave: colour very pale fuscous, glossy; an ill-defined transverse blackish spot before cleft; first segment very slightly speckled with dark fuscous, most evident in extreme apex; second segment lightly strewn with a few blackish scales most evident along nervures and on termen: cilia pale fuscous.

Hind-wing cleft from within $\frac{1}{2}$ and from near base; very pale fuscous, glossy; first segment long, very narrow, apex rather blunt; second segment, long, narrow, subspatulate; third segment linear: cilia pale fuscous, slightly darker costally.

48. **Pterophorus longalis** Wlk. [Fig. 9.]

Wlk., Cat. Lep. B.M., **30**, 943 (1864)—*a*, Cape (*Dregé*).

One specimen, Walker's type, labelled "42/77" (= "Cape; purchased of Dregé").

A *Stenoptilia*; in very worn, torn, and dirty condition.

♀. Expanse about 30 mm. (wings not properly expanded). Palpi rather long, slender, third joint short, pointed, not extending beyond frontal tuft; very pale ferruginous. Head very pale ferruginous on sides, on frons and vertex whitish; frontal tuft very long and beak-like, exceeding diameter of eye. Antennae fuscous, finely ciliated. Thorax and abdomen very pale ochreous, the latter sparsely irrorated with minute black specks; abdomen

Fig. 9.—*Pterophorus longalis* Wlk. Type. Side-view of head.

large and stout, shorter than fore-wing, longer than hind-wing. Fore-leg whitish; tibia very slightly thickened apically; femur with longitudinal groove on lower surface. Mid-leg ochreous-whitish, tibia with slight apical spur, tarsus dark fuscous apically. Hind-leg ochreous-whitish; tibia with pairs of spurs at $\frac{2}{3}$ and apex, inner spurs longer than outer; tarsi broken.

Fore-wing cleft from about $\frac{3}{4}$, dirty whitish-ochreous thickly irrorated with fuscous; two blackish fuscous dots at outer angles of cell before cleft; first segment parallel-sided, apex subfalcate, termen concave, posterior angle rounded and indistinct, colour as base of wing; second segment parallel-sided, apex produced, falcate, termen nearly straight, oblique, tornus distinct, a small blackish dot in middle of termen. Cilia very damaged, but apparently very pale ochreous, almost whitish at base.

Hind-wing cleft from about $\frac{1}{2}$ and a little beyond $\frac{1}{6}$; first segment slightly widened exteriorly, apex acute, termen oblique; second segment subtriangularly dilated exteriorly, apex acute, termen oblique, subconcave; third segment narrow, tornus obsolete: very pale ochreous-whitish lightly irrorated with fuscous, rather glossy: cilia pale fuscous, whitish at base.

49. **Pterophorus defectalis** Wlk. [Fig. 10.]

Wlk., Cat. Lep. B.M., **30**, 943 (1864)—*a–e*. Sierra Leone (*a–b, Morgan*); Congo (*c–e, Richardson*).

a, *b*. Sierra Leone. These two specimens stand first and second in series. They are labelled "42/31" and formed part of 130 Lepidoptera from Sierra Leone presented by Rev. D. F. Morgan. The specimen *a* has subsequently been marked "Type." It is in fair condition and evidently the same species as *oxydactylus* from Ceylon and *congrualis* from S. India.

Expanse 15 mm. Fore-wing cleft from within $\frac{1}{2}$, pale ochraceous-grey; segments linear; a slight longitudinal subcostal fuscous spot at $\frac{1}{3}$, a fuscous costal dot above base of cleft; first segment broadly fuscous at $\frac{1}{2}$ and before apex: cilia pale ochraceous-fuscous, darker along costa, whitish apically, posterior margin of first segment with a slight subapical black scale-tooth and scattered black scales between this and $\frac{1}{2}$ of segment, anterior margin of second segment

Fig. 10.—*Pterophorus defectalis* Wlk. Type. Side-view of head.

paler towards termen with a few heavy black scales about $\frac{1}{2}$, apex of second segment whitish; dorsal cilia short on basal half of wing, with a slight black scale-tooth about $\frac{2}{3}$ beyond which the cilia are intermixed with blackish-fuscous scales, a large mass of long blackish-fuscous hair-like scales at about $\frac{5}{6}$, preceded and followed by white scales.

Hind-wing dark ochraceous-fuscous, cleft from about $\frac{1}{4}$ and from near base, segments linear; cilia fuscous, with a compact group of heavy black scales a little beyond half of dorsum.

Palpi porrect, less than length of head, third joint acuminate and shorter than second, very pale yellowish-grey. Antenna (left one is broken off) pale ochraceous-fuscous. Head and thorax pale ochraceous-fuscous intermixed with darker ochraceous scales; some long scales (apparently bifid at tip) on top of head and around base of antenna. (Abdomen broken.) The only legs remaining are one fore- and one hind-leg. The former is pale ochraceous white; the tibia comparatively short, somewhat suffused with fuscous, dilated terminally with a short terminal spur or acuminate scale-tuft.

Hind-leg long, pale ochraceous-white, dilated with scales at

points of emission of spurs; tibia strongly suffused exteriorly with ochraceous-fuscous, which suffusion broadly encircles the tibia where dilated and extends on to inner side as a longitudinally oblique line before each dilatation; spurs long, subequal, pale fuscous terminally; tarsi long (only three joints remain), pale, obscurely striated and banded with pale ochraceous.

b is similar, apparently a ♀.

c–e are similar. *e* is a very poor ♂ specimen, but has the abdomen perfect, showing a double divergent anal tuft. These three are from a collection from "Congo" made by Surgeon Andrew Curror, R.N. (H.M.S. *Waterwitch*).

50. **Pterophorus rutilalis** Wlk.

Wlk., Cat. Lep. B.M., **30**, 943 (1864)—*a*, Port Natal (*Plant*).

Walker's type of *rutilalis* is labelled "57 40" (= "Port Natal; collected by Mr. Plant; purchased from Stevens").

This is an ordinary specimen of *wahlbergi* Z., and scarcely needs a new description.

51. **Pterophorus congrualis** Wlk.

Wlk., Cat. Lep. B.M., **30**, 943–4 (1864)—*a–d*. South Hindostan (*a*, *Walhouse*); China (*b–c*, *Laye*); Shanghai (*d*, *Ent. Soc.*).

a. Marked "S. Ind. 61/20." Reference to the list of accessions shows that these insects were collected by M. J. Walhouse in Southern India "chiefly near Coimbatoor . . . a few are from the Koondah Range and a few from the Nilgiri Hills." This specimen is of the "pale ochraceous fawn-colour" of Walker's description, and evidently represents his type of *congrualis*; it is quite similar to his *defectalis* from Sierra Leone.

b and *c*. Marked "China. 45/65." The Register quotes these as from Foochowfoo [Fuchaufu] and presented by G. T. Lay. [Not Laye, as Walker writes it.] Both these specimens are ordinary *Exelastis liophanes* Meyr. (to which removed).

d. Marked "Shanghai. 58/60." A worn specimen of a *Pterophorus*, apparently *Pt. lienigianus* (to which removed).

52. **Pterophorus oxydactylus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 944 (1864)—*a–h*, Ceylon (*Nietner*).

Walker only notes eight specimens (*a–h*), but the present series contains ten, all labelled "Ceylon 57/48"; the Register gives these as "collected at Colombo by Mr. Nietner in December."

a. Marked "Type"; the ordinary Colombo form of *oxydactylus*. I fail to see any difference between this and *defectalis* Wlk.

b. No scales in dorsal cilia of hind-wing; it is an ordinary *oxydactylus*.

c, d. *Exelastis liophanes* (to which referred).

e. Ordinary *oxydactylus*. Hind-wing and abdomen lost.

f. *Exelastis liophanes* (to which referred).

g, h, [*i, j*]. Ordinary *oxydactylus*.

54. **Pterophorus canalis** Wlk.

Wlk., Cat. Lep. B.M., **30**, 944 (1864)—*a–b*. Sydney (*a*, *Lambert*); Australia (*b*, *Daniel*).

Walker only describes two specimens, one of which he notes as a var. (var. β). This specimen (Walker's *b*), labelled "Australia 58/124" (= "from Daniel's collection"), had been mislabelled as the type.

Of the remaining four specimens one is labelled "57/130" (= "Australia, Moreton Bay; collected by Diggles; purchased of Stevens"), and may therefore be excluded as the type. The remaining *three* are all labelled "47/73" (= "N. Holland, Sydney; purchased of Lambert through Argent"); one of these must therefore be the type, and I have accordingly moved the type-label to the specimen which best agrees with Walker's description.

All these specimens appear to be ordinary examples of *Stenoptilia zophodactyla*, to which I have removed them. The type has three blackish dots in terminal cilia of *both* segments of fore-wing.

55. **Pterophorus diffusalis** Wlk.

Wlk., Cat. Lep. B.M., **30**, 945 (1864)—*a–b*, Moreton Bay (*Diggles*).

Walker's two specimens are still extant, both labelled "57/130" (= "Australia, Moreton Bay; purchased of Stevens; collected by Diggles").

The specimens, both ♂, are ordinary examples of *Sphenarches caffer*, and as such scarcely need detailed description.

It is characteristic of Walker that he described Sinhalese, African and Australian specimens of the same species as members of two different genera (*Oxypt. anisodactylus* and *O. direptalis* and *Pterophorus diffusalis*).

56. Pterophorus obliteralis Wlk.

Wlk., Cat. Lep. B.M., **30**, 945 (1864)—*a*, Moreton Bay (*Diggles*).

This is an Oxychirotid, not a Pterophorid: it has been redescribed as *Cenoloba obliteralis* by Mr. Meyrick (Trans. N. Z. Inst.).

57. Pterophorus innotatalis Wlk.

Wlk., Cat. Lep. B.M., **30**, 945 (1864)—*a–b*, Auckland, New Zealand (*Oxley*).

Walker's two specimens are still extant, both labelled "60/73" (= "N.Z., Auckland; collected by Oxley; purchased of Stevens"). Superficially similar in general pattern and appearance to the European *Alucita tetradactyla*; Mr. Meyrick gives (Trans. Ent. Soc., 1885, 424) the dark-striped legs of the latter as a difference; the presence of large black scales at base of cilia on dorsum of fore-wing of *innotatalis*, however, appears to be a better distinctive character.

Description of Type.—♂. Expanse 17 mm. Palpi porrect, very short, not visible from above, third joint minute, greyish-ochreous. Antennae finely ciliated, fuscous. Head, thorax and abdomen greyish-ochreous. Fore-leg rather long, slender, fuscous slightly tinged with ochreous. Mid-leg greyish-ochreous, long, slender, tibia with pair of apical spurs, of which the inner is about twice length of outer. Hind-leg long, slender, ochreous-grey; tibia with pairs of spurs at ⅔ and apex, of which the inner spurs are longer than outer, and proximal pair longer and more slender than distal pair, tibia suffused with light fuscous beyond ½, all spurs blackish at tips.

Fore-wing narrow, cleft from rather within ½, both segments linear, subfalcate, widely separated; pale ochraceous, paler (almost whitish-yellow) on segments, especially on second segment: cilia fuscous, blackish at apex and above extremity of second segment, dorsum with a small aggregation of black scales at base of cilia at about ½ and a few scattered black scales posteriorly.

Hind-wing cleft from about $\frac{1}{3}$ and from near base (not "divided into two plumes" as Walker says), segments narrow, linear; fuscous-ochreous thickly irrorated with fuscous: cilia long, light fuscous.

58. **Pterophorus deprivatalis** Wlk. [Fig. 11.]

Wlk., Cat. Lep. B.M., **30**, 946 (1864)– *a*, *b*, New Zealand (*Bolton*).

Walker's two specimens are still extant labelled "54/4, New Zealand" (presented by Col. Bolton: the Register states that these specimens came from Auckland).

This species was arranged in the collection as a *Stenoptilia* but is really a *Platyptilia*, to which genus I have removed it.

Type.—♂. Expanse 16 mm. Palpi porrect, projecting nearly length of head beyond it, straight, third joint short and acuminate, second joint moderately clothed with scales and extending beyond frontal tuft; very pale ochraceous irrorated above with pale

Fig. 11.—*Pterophorus deprivatalis* Wlk. Type. Side-view of head.

ferruginous. Antennae minutely ciliated, pale yellowish-fuscous. Head very pale ochraceous; a long narrow beak-like frontal tuft, from margin of eye to apex of tuft about equal to breadth of eye, Thorax and abdomen pale ochraceous, the latter rather slender but not proportionally long (length about equal to that of second segment of hind-wing), anal tuft paler. Fore-leg whitish-ochraceous, femur suffused with pale ferruginous, tibia slightly dilated apically and striated with brownish-ferruginous, apices of tarsi suffused with brownish-ferruginous. Mid-leg whitish ochraceous; apex of tibia dilated and suffused with brownish-ferruginous, emitting a pair of equal spurs; apices of tarsi suffused with brownish-ferruginous. Hind-leg whitish ochraceous; tibia banded with brownish-ferruginous before $\frac{1}{2}$, at $\frac{2}{3}$ and at apex, emitting two pairs of moderate equal spurs, scarcely dilated at points of emission of spurs; tarsi suffused apically with brownish-ferruginous.

Fore-wing rather slender, cleft from about $\frac{1}{5}$; first segment parallel-sided, apex falcate, not prominent, second segment broader than first, scarcely dilated, termen subsinuate, oblique, anterior angle moderately acute, tornus well marked: very pale ochraceous

lightly irrorated with pale ferruginous; costa dotted with ferruginous between base and ½ and with an elongate interrupted ferruginous streak from ½ widening posteriorly into a small ill-defined costal triangle at ¾, its apex obsolescent below vein 8; first segment with a broad but ill-defined pale ferruginous inwardly-oblique transverse bar occupying its central third, preceded by paler costal area, subterminal area paler; second segment lightly suffused with pale ferruginous. Cilia whitish, blackish at angles of both segments, dorsum with a small black scale-tooth at ⅔.

Hind-wing cleft from about ½ and ⅙; first segment regularly dilated posteriorly, posterior angle well marked, termen subconcave, oblique; second segment scarcely dilated posteriorly, termen very oblique; third segment parallel-sided, sublinear; fuscous, with a slight ferruginous tint. Cilia fuscous, blackish at base on termen of first segment, blackish on termen towards posterior angle of first segment, third segment with a few black scales at ½ scarcely forming a tooth.

21. **Aciptilus candidalis** Wlk.

Wlk., Cat. Lep. B.M., **30**, 948 (1864)—*a*, Sierra Leone (*Foxcroft*).

Walker's type is labelled "58/166. Sierra Leone" (= "collected in 1858 by Jas. Foxcroft in the Peninsula around Sierra Leone").

Expanse about 15 mm. (wings deflexed). Palpi very short, filiform, acuminate, whitish slightly suffused with reddish-fuscous at tips. Antennae white, shortly ciliated. Head, thorax and abdomen pure white, slightly suffused (especially on sides of abdomen) with very pale yellow. Fore- and mid-legs white. Mid-tibia slightly dilated at apex and emitting a pair of apical spurs of which the inner is much the longer. Hind-legs white very slightly suffused with very pale yellow; inner tibial spurs longer than outer.

Fore-wing narrow, cleft from well within ½ (nearly ⅔), segments narrow, linear; rather roughly scaled, white, very faintly tinged with very pale yellowish: a few dark scales at base of cleft and apex of first segment, but in both places minute and inconspicuous. Cilia white, cut on hinder margin of first segment with narrow very pale fuscous wisps at ½ of segment and subapically.

Hind-wing cleft to ¼ and base; colour as fore-wing, apices of segments minutely blackish especially on first segment. Cilia white, very pale fuscous basally at ¾ of second segment.

Note.—The darker coloration of the cilia is not evident except on very minute inspection.

22. **Aciptilus lacteipennis** Wlk. [Fig. 12.]

Wlk., Cat. Lep. B.M., **30**, 949 (1864)—*a*, Hindostan (*Clark*).

Walker's type is labelled "43.43 E. Indies." I believe that it came from Moulmein.

♀. Expanse 27 mm. Palpi long, slender, filiform, projecting more than length of head beyond it, third joint as long as second, acuminate (scaleless, apparently originally white). Antennae white, basal joint very long and enlarged. Head, thorax and abdomen white. Fore-leg white, tibia slightly suffused with dark fuscous, first tarsal joint dark fuscous exteriorly. (Mid-legs broken.) Hind-leg long, slender, white; tibia with a minute tuft of black scales a little beyond $\frac{1}{2}$ in position of tibial tuft found in *monodactylus*, spurs long, blackish at tips, inner spurs longer than outer,

Fig. 12.—*Aciptilus lacteipennis* Wlk. Type. Side-view of head.

points of emission of spurs very slightly dilated with long hair-scales, apex of tibia with minute dorsal tuft of black scales. Apices of first and second tarsal joints slightly suffused with very pale brownish, apex of third tarsal joint minutely black, last two joints broken.

Fore-wing narrow, cleft to $\frac{1}{4}$, segments linear; white, a few scattered black scales around cleft and along segments; small clusters of black scales on first segment at $\frac{1}{5}$, $\frac{2}{5}$, $\frac{3}{5}$, and $\frac{4}{5}$, of its length, on second segment at about $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ of its length, of which that at $\frac{3}{4}$ of second segment is the largest and most conspicuous, occupying the whole width of segment. Cilia white with very pale yellowish-fuscous wisps on hinder margin of first segment at $\frac{1}{3}$, $\frac{2}{3}$ and $\frac{1}{5}$ of its length, on fore margin of second segment at about $\frac{1}{4}$ of its length, and on dorsum at $\frac{1}{2}$, $\frac{2}{3}$ and (very faintly discernible) at $\frac{5}{6}$.

Hind-wing cleft from about $\frac{1}{5}$ and from base, segments linear: white, scales around base of upper fissure tipped with brownish, second segment with a conspicuous cluster of black scales at about $\frac{2}{5}$ of its length (outer $\frac{1}{2}$ broken off); third segment hidden under second (left hind-wing broken). Cilia white, on costa with a streak of very pale fuscous at about $\frac{2}{3}$.

23. **Aciptilus leucadactylus** Wlk.

Wlk., Cat. Lep. B.M., **30**, 949 (1864)—*a–c*, Ceylon (*a–b, Templeton*; *c, Nietner*).

Walker's three specimens are extant. The type and one other are labelled "52/62" (= "Ceylon; collected and presented by R. Templeton"), the third one is labelled "57/48" (= "collected by Mr. Nietner at Colombo in December.").

Of these the last is an ordinary *candidalis*, and of the first two one is *candidalis*, the other *niveodactyla* Pag. The specimen of *candidalis* has been marked "Type," with which I concur to avoid altering the synonomy, as there seems nothing to indicate which Walker regarded as his type.

Description of the Type.—Expanse 22 mm. (not measured to extreme apices which are curved posteriorly). Exactly similar to type *candidalis* except for larger size, slightly deeper yellow colouring and absence of darker wisps in cilia; the cilia, however, are decidedly discoloured and bedraggled so that this difference scarcely appears great.

24. **Aciptilus similalis** Wlk. [Fig. 13.]

Wlk., Cat. Lep. B.M., **30**, 949 (1864)—Sarawak, Borneo (*Saunders*, B.M., 1894).

Walker's type from Sarawak (Saunders' coll.) is still extant, though unset and in poor state. No other specimens are in the B.M. collection.

♂. Expanse about 21 mm. (possibly a little more; this is double length of the right fore-wing; the left fore-wing is broken at $\frac{1}{2}$). Palpi moderately short, thin, filiform, third joint subequal to (not longer than) second, acuminate, shorter than diameter of eye; whitish. Antennae white; basal joint enlarged, but scarcely so abruptly separated from remainder of antennal stalk as in *lacteipennis*. Head, thorax and abdomen white, the last long and slender; anal tufts white, long, parallel, one dorsal and a pair of lateral hair-pencils. Fore-leg white, tibia banded at $\frac{1}{3}$ and $\frac{2}{3}$ with dark fuscous and with a dark fuscous acuminate scale-tuft at apex, first tarsal joint faintly banded with dark fuscous. Mid-leg white, tibia lined with blackish and with brownish scale-tufts at $\frac{1}{4}$ and apex; spurs broken. Hind-leg white, tibia with a minute brownish dorsal scale-tuft before $\frac{1}{2}$, inner spurs longer than outer (tarsi broken).

Fore-wing cleft from $\frac{2}{5}$; segments linear; white, irregularly strewn with a few brownish-fuscous scales especially evident around base of cleft; first segment with clusters of blackish-brown scales at about $\frac{1}{3}$ and $\frac{2}{3}$, and with a small cluster of blackish scales at about $\frac{3}{4}$ of its length; second segment with small blackish costal dots at $\frac{1}{3}$ and $\frac{2}{3}$ and a minute subapical dot on termen. Cilia white, with wisps of extremely pale fuscous on costa at $\frac{2}{3}$, on hinder margin of first segment at $\frac{1}{3}$ and $\frac{2}{3}$ of its length, on fore margin of second

Fig. 13.—*Aciptilus similalis* Wlk. Type. Side-view of head.

segment (cilia too pressed down to make out anything), on dorsum opposite base and cleft and blackish dots on second segment.

Hind-wing cleft from about $\frac{1}{4}$ (? $\frac{1}{3}$) and from base; white, with a few scattered minute blackish scales especially evident around base of cleft, apices of segments with a very minute black dot; second segment with a single black scale at $\frac{1}{6}$ and a black dot at $\frac{1}{2}$ of its length. Cilia white, with wisps of very faint yellowish-brown or pale fuscous on costa at a little beyond $\frac{2}{3}$, on hinder margin of second segment at $\frac{1}{2}$ and $\frac{3}{4}$ of its length, and narrowly and shortly blackish basally opposite black dot on hinder margin of second segment.

This species seems to come extremely near to *lacteipennis*.

25. **Aciptilus aptalis** Wlk. [Fig. 14.]

Wlk., Cat. Lep. B.M., **30**, 950 (1864) –*a–g*. Sydney (*a–d*, *Lambert*; *e–f*, *Diggles*); Australia (*g*, *Daniel*).

All seven of Walker's specimens are still extant. One of Lambert's is marked as the type.

Fig. 14.—*Aciptilus aptalis* Wlk. Type. Side-view of head.

Palpi very short and minute, filiform, acuminate, not projecting beyond head. Vertex of head and front of thorax whitish.

Fore-wing, the cilia very pale whitish-yellowish, white on basal half of costa.

The hind-wings are scarcely "white"—rather white minutely irrorated with fuscous, apices of segments dotted with blackish; cilia whitish.

Otherwise as in Meyrick's redescription (Trans. Ent. Soc., 1885, 424-5). The *type* has the transverse scales at base of cleft of fore-wing reddish-brown rather than blackish. The spots on first segment, costal at $\frac{1}{2}$ and dorsal at $\frac{3}{4}$ of its length, and on second segment dorsal at $\frac{1}{2}$, $\frac{2}{3}$ (largest) and $\frac{3}{4}$ of its length, are black; apical spots on segments are blackish-brown.

This seems a distinctly variable species in its coloration. It does not seem in any way related to *similalis*, as suggested by Meyrick. It seems to me to be fairly near *monospilalis*.

26. **Aciptilus furcatalis** Wlk. [Fig. 15.]

Wlk., Cat. Lep. B.M., **30**, 950 (1864)—*a-f*. New Zealand (*a–d, Bolton*); Auckland (*e–f, Oxley*).

Walker's six specimens are still extant. He describes two varieties with the "hind branch of the stripe"

Fig. 15.—*Aciptilus furcatalis* Wlk. Type. Side-view of head.

"partly" and "quite obsolete." His type must therefore be one of the two specimens in which both "branches" of the stripe are present. Only two of these answer this description, and I have therefore shifted the type-label on to one of these; the type-label had previously been put on one of Walker's var. γ, which is apparently *lycosema* Meyr. This true type and two others (one *furcatalis* and one *lycosema* = var. β of Wlk.) are labelled "60/73" and are from Auckland, N.Z. (Oxley coll.). Three others (all *lycosema* = var. γ of Wlk.) are all labelled "54 4" (= "Auckland, N.Z.; Colonel Bolton coll."). Walker thus made a mistake in attributing four specimens to Col. Bolton; there were really three each from the collections of Bolton and Oxley.

Type.—Expanse 20 mm. Palpi minute, filiform, acuminate, not visible from above, whitish. Antennae slightly serrate, minutely ciliated, whitish. Head white, a few whitish-ochreous scales between the eyes and on collar. Thorax ferruginous-brown. (Abdomen broken.) (Fore-leg broken.) Mid-leg white, tibia irrorated with ferruginous-brown, inner apical spur longer than outer. (Hind-legs broken.)

Fore-wing moderately broad, cleft to about $\frac{2}{3}$, first segment broader at base than second, both segments decreasing rapidly posteriorly, acuminate, slightly subfalcate: ferruginous-brown, white on costa to $\frac{2}{3}$ gradually broadening posteriorly but not reaching half-way across wing; first segment with a longitudinal white bar on costa at $\frac{1}{2}$ length of segment; second segment with a longitudinal white mark at base of cleft extended along fore margin to apex as a narrow white line. Cilia on costa ferruginous-brown, white opposite white spaces, blackish between outer white space and apex; within cleft whitish; on dorsum whitish, ferruginous-brown from $\frac{1}{3}$ to tornus.

Hind-wing cleft from within $\frac{1}{2}$ and from base, segments sublinear, white. Cilia white, pale fuscous at apex of first two segments.

27. **Aciptilus monospilalis** Wlk. [Fig. 16.]

Wlk., Cat. Lep. B.M., **30**. 950 1 (1864)—*a–l*, New Zealand (*a–f, Sinclair*; *g–l, Bolton*).

Walker's twelve specimens are all still extant. The one marked type is labelled "54 1" (= "Auckland, N.Z.; Col. Bolton").

Fig. 16.—*Aciptilus monospilalis* Wlk. Type. Side-view of head.

♂. Expanse 23 mm. Palpi minute, not visible from above, filiform, acuminate, yellowish-white. Antennae white, finely ciliated (about $\frac{1}{4}$). Vertex of head roughened with long white hair-like scales. Head, thorax and abdomen white; anal tuft long, white, pointed. Fore-leg white, lined with blackish-fuscous on lower surface, tibia with a small apical scale-tuft. Mid-leg white, tibia with a pair of black-tipped apical spurs, of which the inner is the longer. Hind-leg broken (in another specimen it is

white, the anterior $\frac{1}{2}$ thickly clothed with *long fine white hairs*, with pairs of black-tipped spurs (of which the inner spurs are longer than outer) at $\frac{2}{3}$ and at apex).

Fore-wing rather narrow, cleft to about $\frac{1}{2}$, segments sublinear, very slightly falcate: white with dark reddish-brown markings, viz., a longitudinal dot on dorsum at $\frac{1}{3}$, a spot at base of cleft, costal dots at $\frac{1}{3}$ and $\frac{2}{3}$ of first segment, a dorsal dot at $\frac{2}{3}$ of second segment and one at apex of second segment, with a few scattered scales more evident on exterior half of the wing; a minute blackish dot in extreme apex of first segment. Cilia white, on costa slightly tinged with brownish, on dorsum narrowly brownish at base at about $\frac{3}{4}$ and $\frac{7}{8}$. Hind-wing and cilia white.

One specimen from Wellington, labelled "1908 122." is wholly white, with a large brownish blotch at base of cleft extended as a few scattered brownish scales along lower margin of second segment, and with outer half of costa of first segment broadly brownish.

The hairy hind-tibia seems peculiar, but I see that *lycosema* also possesses it; in *furcatalis* the "hairy" portion does not seem to extend beyond $\frac{1}{2}$.

The following remarks apply to the hind-legs of some of these species of *Alucita*:—

aptalis has a few short hairs between base and about $\frac{1}{3}$ of hind-tibia.

innotatalis has no hairs.

tetradactyla has no hairs.

xanthodactyla has no hairs.

lacteipennis (type) has remains of short hairs reaching to beyond $\frac{1}{2}$.

albidus (a specimen from Natal so labelled) has no long hairs, but a trace of a short bristly scrubby patch of scales in normal position of *monodactylus*' acuminate tuft.

lacteipennis (*? melanopoda*) from Nicobars has no long hairs, but a distinct "monodactyloid" tuft.

Utuca Wlk.

Wlk., Cat. Lep. B.M., **30**, 951 (1864).

Redescribed by Lord Walsingham (Ent. Mo. Mag., 1891, 260–261). A casual inspection would have shown Walker that his type-specimen has the hind-wing cleft into three lobes, the first two being (in this particular specimen) badly set out.

Palpi upturned, not reaching vertex, rather filiform, acuminate, joints of segments scarcely visible, finely and smoothly scaled.

Lord Walsingham states (*l.c.*) that the hind-legs have equal spurs. This is not so; the inner spurs are longer than outer and the proximal pair is much larger than the distal pair.

Utuca ochracealis Wlk. [Figs. 17, 18, 19.]

Wlk., Cat. Lep. B.M., **30**, 951 (1864)—*a*, Ega (*Bates*).

♀. Expanse 23 mm. Palpi shaped as noted in generic description, fuscous, blackish towards apex. Antennae fuscous, minutely

Fig. 17.—*Utuca ochracealis* Wlk. Type. Side-view of head.

ciliated. Head fuscous, greyish between eyes, blackish on vertex. Thorax and tegulae reddish-orange; metathorax scaleless but apparently greyish. Abdomen whitish with a rather narrow

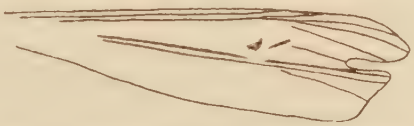

Fig. 18.—*Utuca ochracealis* Wlk. Type. Fore-wing neuration (as far as visible).

fuscous central band extended anteriorly along dorsal line for a distance about equal to its own breadth. [The type certainly has no sign of the "four transverse bands," etc., of Lord Walsingham's description.] Fore-leg blackish-fuscous, tibia slightly dilated apically. Mid-leg fuscous, tibia with an apical pair of spurs of

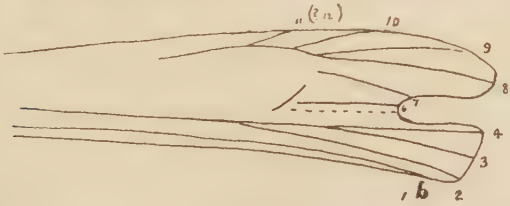

Fig. 19.—*Utuca ochracealis* Wlk. Fore-wing neuration (from another specimen).

which the inner is the longer. Hind-leg long, slender, fuscous, last four tarsal joints greyish; tibia with pairs of spurs at beyond ⅔ and at apex, inner spurs the longer.

Fore-wing narrow at base, dilated exteriorly, cleft to about ⅞, the cleft shallow, notch-like; both segments with outer angles rather rounded but appreciable; dark fuscous. Cilia dark fuscous.

Hind-wing cleft from ½ and base; first segment lanceolate; second segment slightly broadened posteriorly, apex pointed; third segment sublinear: dark fuscous. Cilia dark fuscous, blackish at apices of first and second segments. Third segment has apparently two veins, but I can only see one with certainty; this is very strong and runs along fore margin of segment.

Underside fuscous brown (in some specimens whitish-grey along costa; not so in type).

Sochchora Wlk.

Wlk., Cat. Lep. B.M., **30**, 952 (1864).

Palpi long, sickle-shaped, ascending, smooth, reaching well beyond vertex, third joint shorter than second but long and sharp-pointed.

Sochchora donatella Wlk. [Fig. 20.]

Wlk., Cat. Lep. B.M., **30**, 952 (1864)—*a-d*, Ega (*Bates*).

There were seven specimens in this series, all collected at Ega by Bates and all in the B.M. collection before 1864. Of these one is a *Deuterocopus* * and another apparently a distinct species of *Sochchora* † with the apex of first segment of hind-wing pure white. Of the remaining five specimens, four are of a dark reddish-fuscous colour (presumably Walker's "variety"), the fifth (the Type) is of a rich ferruginous-brown.

Description of Type.—? ♀. Expanse about 13 mm. Palpi as above described under *Sochchora*, rich brownish-ferruginous. Antennae blackish dotted with white. Head rich brownish-ferruginous. (Thorax mouldy—apparently rich brownish-ferruginous, posteriorly whitish-ochreous.) Abdomen large, stout, bright golden-ferruginous mottled and streaked with dark brown and blackish; a narrow whitish transverse band near base and a

* Described by me in Trans. Ent. Soc., 1910, pp. 140–141, as *Leptodeuterocopus sochchoroides*.

† Described by me in Entom., 1911 (Novem.), as *Sochchora albipunctella*.

narrow whitish transverse bar near basal margin of sixth segment. Fore-leg ferruginous; tibia dilated at apex into an acuminate scale-tuft; tarsus blackish apically. Mid-leg golden-ferruginous; tibia with small scale-tufts at ½ and apex, the latter emitting a pair of long black-tipped spurs of which the inner is a little the longer; tarsus blackish-fuscous apically, joints with minute apical scale-tufts. Hind-leg golden-ferruginous irrorated with brownish-ferruginous; tibia with pairs of very long spurs at ⅔ and apex; the proximal pair of spurs (of which the inner spur is the longer) is longer than the distal pair, which are subequal; tibia thickened at points of emission of spurs with small tufts of blackish spinous hairs and with traces of whitish bars above these; tarsal joints suffused with blackish except basally and dilated apically with minute spinous hairs.

Fore-wing rather broad, cleft from about ⅓, costa moderately arched, apex acute, subfalcate, termen of first segment concave, of second sinuate, tornal angle well marked; segments slightly

Fig. 20.—*Sochchora donatella* Wlk. Type. Side-view of head.

broadened posteriorly, subequal: rich ferruginous-brown minutely irrorated with golden-ferruginous: costa narrowly blackish, especially evident apically, cut at ¾ and ⅚ by narrow inwardly-oblique ochreous streaks, narrowly ochreous subapically; a subbasal blackish transverse spot on costa; a short blackish longitudinal streak in disc at ⅓, preceded and followed by a few ochreous scales and with a few ochreous scales between this and dorsum; a conspicuous, transverse, slightly outwardly oblique, black bar on discocellulars, enlarged anteriorly, preceded and followed by an indistinct patch of lilacine scaling most evident towards dorsum, which it reaches. First segment, basally with an ill-defined costal patch of ochreous scales and a minute cluster of lilacine scales towards hinder margin, cut transversely at ⅔ by a narrow white line; second segment cut transversely at ⅔ by a narrow white line not reaching dorsum. Cilia on costa black cut with ochreous opposite ochreous markings, at apex broadly black, on termen of both segments ochreous-grey with a broad black basal bar, within cleft greyish-ochreous blackish on exterior third, a narrow dark fuscous wisp at tornus, on dorsum pale ochreous with minute black scale-teeth beyond ½ and at ⅔.

Hind-wing cleft from about $\frac{2}{3}$ and $\frac{1}{5}$; first segment slightly dilated, apex very square and exterior angles both well marked; second segment narrow, acute, dilated dorsally, termen very oblique, third segment very narrow and linear (reminding one of *Deuterocopus*): bright ferruginous, first two segments (except base) suffused with blackish-fuscous, terminal third of third segment black. Cilia greyish-ochreous; on costa and termen of first segment dark fuscous, broadly black basally on termen; on second segment with a minute apical black scale-tooth, a moderate black tooth at anal angle, and a very small black scale-tuft on hinder margin at about $\frac{3}{4}$ of its length; on third segment with terminal half of fore margin roughened with black scales; dorsum with a large black subapical scale-tooth and a small black tooth opposite base of second cleft.

The four other specimens (Walker's "variety") seem precisely similar in shape, scale-tufts, pattern of markings, etc., but the colouring of the whole insect is much darker, being suffused with blackish, and giving the moth quite a different general appearance.

Alucita punctiferella Wlk. [Fig. 21.]

Wlk., Cat. Lep. B.M., **35**, 1846 (1866)—*a*, "Honduras" [= British Honduras] (*Dyson*).

Fig. 21.—*Alucita punctiferella* Wlk. Type. Side-view of head.

? ♀. Expanse about 10–11 mm. (wings deflexed). Palpi porrect, rather drooping, long, slender, third joint subequal to second (slightly longer, if anything), subfiliform, acuminate: whitish grey, suffused with ochreous apically. Antennae stoutly built, minutely ciliated; whitish. Head and thorax greyish-white slightly suffused with pale ochreous and minutely irrorated with dark fuscous. Abdomen stout, whitish-ochreous, intersegmental incisions irrorated with dark fuscous most evident on dorsum of anterior segments and less so laterally on posterior segments. Legs shining whitish, with a very slight yellowish tint; posterior tibia with two pairs of spurs, of which the inner are the longer, anterior portion of tibia clothed with long pale ochreous hairs which also form minute dorsal tufts at points of emission of spurs.

Both wings cleft into six segments to near base. Fore-wing greyish-white; first segment on basal fourth thickly irrorated with pale ochreous except on four positions on costa of which the first two are merely specks and all of which are preceded and followed by blackish-fuscous, and the fourth is also margined dorsally with blackish-fuscous; a transverse blackish spot at $\frac{1}{3}$ and another before $\frac{1}{2}$, the area between these spots suffused with pale yellowish; exterior $\frac{1}{2}$ of segment obscurely irrorated with pale ochreous and fuscous tending to form transverse bars and especially evident near apex; segments two to six crossed transversely by six broad bars of pale yellowish preceded and followed by narrow dark fuscous lines, the penultimate bar and the next but one between that and base of wing being the most distinct and usually pale ochreous enclosed by blackish, ultimate bar reaching apices of segments which are thus tipped with dark fuscous. The inner dark bar (fourth from termen) is distinctly interrupted and shifted basad on third segment. Cilia concolorous with adjacent portions of segments.

Hind-wing greyish-white, crossed transversely by six broad pale yellowish bars, narrowly preceded and followed (except sixth) by blackish-fuscous, third and fifth most distinct and slightly more ochreous in tint, but the markings of hind-wing are scarcely so well defined as on fore-wing; apices of segments tipped with blackish. Cilia concolorous with adjacent portions of segments.

This type-specimen is labelled "Honduras, 45/123" (= "Honduras; purchased of Dyson").

Orneodes brunnea n. sp. [Fig. 22.]

Alucita hexadactyla [*nec* Hb., Wlk., Cat. Lep. B.M. XXX, p. 953 (1864), specimen *g*.

One specimen labelled "55/44" (= "Villa Nova, Amazons; Bates Coll.; purchased of Stevens").

? ♀. Expanse 17 mm. Palpi porrect, subascendant, second joint moderately long (exceeding diameter of eye), thickened triangularly with roughened scales, third joint about half length of second, rather thick, blunted at apex; greyish fuscous, irrorated exteriorly with dark fuscous, terminal joint dark fuscous except at extreme apex. Antennae light fuscous dotted with fuscous; basal joint anteriorly with a tuft of dark fuscous hair-scales. Head, thorax and abdomen greyish sprinkled with fuscous; head with two long tufts of scales from base of antennae, passing above eyes and nearly meeting on frons. Fore-leg and mid-leg fuscous, tibia

with long tuft of scales; hind-leg pale fuscous with the usual spurs.

Fore-wing cleft as in *hexadactyla*, dull brownish-fuscous; first segment dark fuscous cut by about ten whitish lines tending to form pairs and sometimes joined along hinder margin of segment; other segments cut by whitish lines before and beyond $\frac{1}{2}$, at $\frac{3}{4}$, at $\frac{5}{8}$ and subterminally. Cilia brownish-fuscous, whitish opposite whitish lines; on segments two to five conspicuously more thickly

Fig. 22.—*Orneodes brunnea* n. sp. Type. Side-view of head.

scaled and darker as a broad transverse fascia across wing at $\frac{1}{3}$ and again at $\frac{2}{3}$, the inner fascia fairly straight, the outer fascia slightly displaced basewards on segments four to six, shafts of segments between these fasciae conspicuously dark against intervening cilia which are here slightly paler than elsewhere.

Hind-wing cleft as in *hexadactyla*; segments brownish-fuscous cut by about seven whitish lines which are continued on to the adjacent cilia, apices of segments blackish. Cilia concolorous with portions from which they arise, conspicuously darker at about $\frac{1}{4}$ and $\frac{3}{5}$, thus forming two dark bands across the wing.

Paelia Wlk.

Wlk., Cat. Lep. B.M., **35**, 1846 (1866).

Palpi short, depressed, thickly but smoothly scaled, third joint shorter than second.

Paelia lunuligera Wlk. [Fig. 23.]

Wlk., Cat. Lep. B.M., **35**, 1846 (1866)—*a*, Ega (*Bates*).

Type.—♂. Expanse 16 mm. Palpi as described above, dark fuscous. Antennae dark fuscous, finely ciliated (over 1). Head dark fuscous, greyish-white between eyes and base of antennae. Thorax dark fuscous, slightly irrorated with greyish. Abdomen dark fuscous, intersegmental divisions whitish especially evident posteriorly. Fore-leg dark fuscous, tibia and tarsi bounded apically with white. Mid-leg dark fuscous, tibia with a pair of apical black-tipped spurs of which the inner is the longer; tibia, tarsi and spurs banded with white. Hind-leg dark fuscous banded with white, tibia with two pairs of spurs of which the inner are the longer.

Fore-wing triangular, broad, apex acute, termen straight, tornus well marked; cleft into six segments from about $\frac{1}{2}$, second cleft from about $\frac{2}{3}$, third shortest, fifth deepest. Blackish-fuscous with a coppery tinge in certain lights, minutely irrorated with greyish white; costa cut transversely by six pairs of narrow short white streaks, the first two pairs scarcely evident; on first segment the fifth and sixth pairs of these white streaks are continued as lines across the segment, apex of segment black; second segment blackish on terminal half, cut transversely at about half its length by two narrow white lines and subterminally by a similar white line; third segment near base with obscure indications of two transverse

Fig. 23.—*Paelia lunuligera* Wlk. Type. Side-view of head.

white lines, cut subterminally by a pair of sharp white lines, blackish towards termen, fourth segment blackish towards termen, cut transversely by sharp white lines at $\frac{1}{2}$ and beyond $\frac{3}{4}$ of its length; fifth segment cut at about $\frac{2}{3}$ and $\frac{5}{6}$ by sharp white lines; sixth segment cut beyond $\frac{1}{2}$ and at $\frac{5}{6}$ by sharp white lines. Cilia dark fuscous, blackish on termen, whitish at base of clefts, white opposite white lines, on costa blackish between pairs of white streaks.

Hind-wing cleft into six segments, third and fifth clefts deepest, to about $\frac{1}{3}$, other clefts to about $\frac{1}{2}$. Blackish-fuscous, irrorated with whitish-grey, especially towards base, segments cut by three narrow white bars most evident posteriorly. Cilia concolorous with portions of wing from which they originate.

To casual examination with the naked eye the wings appear uncleft.

This type-specimen is labelled "Para; 50/45" (= "S. America, Para, etc., Wallace and Bates: purchased of Stevens").

The frenulum is long and strong in type *lunuligera*.

February 5, 1926.

The Larva of Suhpalacsa (*Neuroptera*): *A Correction.*

In my paper "Some Aspects of the Biology and Morphology of the Neuroptera, with special reference to the immature stages and their possible phylogenetic significance" in Trans. Entom. Soc. London, 1924, p. 342, I mentioned on the authority of van der Weele (Cat. Coll. Zool. Selys, Fasc. VIII, 1908) that the larva of *Suhpalacsa* was similar to that of *Nymphes* in possessing a one-toothed mandible. Dr. Tillyard has very kindly written to me correcting this. He says "Froggatt had sent a larva to van der Weele as that of *Suhpalacsa flavipes* and van der Weele had figured it as such, when, in reality, this larva was that of the Myiodactylid *Osmylops pallidus* Bks. I have reared this larva again and again, and know its whole life-history too. The eggs are large and laid singly or in small groups on the undersides of leaves, hanging down on long, slender stalks. The larva is bright green and very flattened, with very long abdominal lateral processes, and it sits with its jaws held wide open at an angle of more than 180 degrees, and snaps at anything which passes its way. This larva agrees with that of *Nymphes* in having a single large internal tooth on the mandible: in other respects it is so different that I do not hesitate to keep the two families distinct. *Suhpalacsa*, *Acmonotus* and *Stilbopteryx* all have very different larvae from this, of the Ascalaphid type, with *three* large internal teeth on each mandible."

These observations are most interesting and important and it is to be hoped that Dr. Tillyard will soon publish a full account of this peculiar family, the Myiodactylidae, together with his opinions thereon. My own acquaintance with the family is, as I have said, very slight and I would not attempt to speculate now upon its affinities. Dr. Tillyard's observations prove that the *Suhpalacsa* larva is not an exception to the Ascalaphidae as had been thought previously.

C. L. Withycombe.

August 18, 1925.

THE

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

For Report of the British National Committee on Entomological Nomenclature omitted from this volume, vide A.5763.

LONDON:
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QUEEN'S GATE, S.W. 7

1925–1926.

THE

PROCEEDINGS

OF THE

ENTOMOLOGICAL SOCIETY

OF

LONDON

FOR THE YEAR 1925.

Wednesday, 4th February, 1925.

Professor E. B. POULTON, F.R.S., President, in the Chair.

Nomination of Vice-Presidents.

The PRESIDENT announced that he had nominated Professor W. BATESON, F.R.S., Mr. G. C. CHAMPION, and Mr. E. E. GREEN, as Vice-Presidents for the coming year.

Library.

The SECRETARY announced that the Council had decided to discontinue the opening of the Library on Wednesday evenings (except on the nights of meetings), after the 31st March, 1925, and to revert to the previous times for the opening of the Library.

Exhibitions.

A MACROPTEROUS FORM OF CHORTHIPPUS PARALLELUS ZETT.—Mr. W. J. LUCAS said :—

"It is well known that the Natural Order Orthoptera, like other archaic groups of insects, contains many forms with organs of flight in a rudimentary condition, or even entirely absent. Very occasionally, however, an insect of this kind appears with them well developed. I know for certain of

but five such examples, amongst the Orthoptera, having been captured in the British Isles:—a specimen of *Conocephalus dorsalis* Latr., taken by W. H. Harwood near Clacton, Essex, in August 1899; a female of *Metrioptera brachyptera* L., found by G. Fox-Wilson at Wisley, Surrey, on August 3, 1921; a female of *Metrioptera roëselii* Hagenb., taken by B. S. Harwood at Clacton on August 16, 1922; a female of *Chorthippus parallelus* Zett., taken by G. C. Champion at Looe, S. Cornwall, in September 1922; and the female of the same species, now exhibited, taken by myself in the New Forest on October 17, 1924. *C. parallelus* with more fully developed elytra and wings seems to agree with Charpentier's *Gryllus montanus*, of the female of which he says: '*elytris . . . in foemina tertia parte thorace capiteque longioribus: alis dimidia elytrorum parte paullo majoribus.*' This I take to mean—'With the elytra in the female longer by a third than the thorax and head together: with the wings a little greater than half the elytra.' This diagnosis describes very well the insect exhibited. In the normal male of *C. parallelus* the elytra are well developed, but the wings are in a condition similar to those of the normal female. For comparison, a normal female and an elytron and wing from a normal female are also exhibited. The occurrence of these exceptional macropterous forms lends colour to the probability of such Orthoptera having been derived from winged forms; but that owing to their manner of life they have now found it unnecessary to use material and energy in elaborating organs of flight! Even with this superior equipment in the matter of elytra and wings the insect before us, being of a somewhat bulky build, does not appear capable of flying to any great extent. Judging from experience, however, of some of our own grasshoppers, they seem to use their wings mainly in order to assist their leaps; for they move in almost straight lines, though it may be of several yards, and in order to take a new direction make a fresh start from the ground."

Lepidoptera from Lancashire.—Mr. W. G. Sheldon exhibited on behalf of Mr. W. G. Clutton of Burnley the following Lepidoptera, all from Lancashire. A melanic male and two melanic females of *Hybernia defoliaria*, and a gynan-

drous specimen of the same species, possessing on the right side rudimentary wings, and a male antenna; a series of *Encromia rufana*; one of *Cacoecia costana*, with its melanic form, *liverana* Mansbridge; a long and variable series of *Epiblema solandriana*, and series of *Depressaria alstroemeriana* and *D. nanatella*.

A MOTH FROM CENTRAL ASIA.—H. M. EDELSTEN exhibited a photograph of a moth from Central Asia supposed to be *Leucania brevilinea* Fenn., sent by R. Püngeler of Aachen, with British specimens of *L. brevilinea* for comparison. The example was rather larger than British ones. *L. brevilinea* has hitherto been looked on as peculiar to Britain.

THE MEANS OF INSECT DISTRIBUTION.—Mr. C. S. ELTON (introduced by Prof. POULTON) exhibited lantern slides in illustration of the distribution of insects, exemplified by observations made on the recent Oxford University Expedition to Spitzbergen.

THE BUTTERFLY AND CHRYSALIS AS A SYMBOL IN ANCIENT RELIGIOUS BELIEFS.—The PRESIDENT exhibited on the screen the four scenes depicted on the Cretan ring recently obtained by Sir Arthur Evans, F.R.S. (Proc. Ent. Soc., 1924, p. lxxix), who had kindly lent the slides. The series indicated the existence, at about 1500 B.C., of an extremely complex belief to the understanding of which the two butterflies and their pupa-cases furnished the essential clue. An additional photograph, also lent by Sir Arthur Evans, showed the persistence of the same symbolism into Roman times. This illustration, reproduced from an engraved gem, showed the skeleton of a man emerging from an urn of which the lid was raised by a winged, torch-bearing figure representing life. The arms of the skeleton were reaching down for the arms and armour at the base of the urn, while above the head the soul returning to the body was symbolised by a butterfly.

ANT-LIKE HETEROMEROUS BEETLES OF TWO SPECIES (ANTHICIDAE) TAKEN WITH THEIR MODEL ON A CACAO TREE IN S. NIGERIA.—The PRESIDENT said that he had received from Mr. F. D. Golding, Second Entomologist of the Nigerian Agricultural Dept., the following specimens which were exhibited to the meeting:—four examples of the Anthicid

observed that this phalanx stretched across its entire length, a distance of forty-two miles.

"At Colon, on the evening of August 23rd, hordes of this moth were attracted to the lights of the liner, and many entered through her portholes. They were joined here by a great number of the Sphingid *Sesia titan*, which, together with the Noctuid *Euclystis guerini* Guen., had come to the 'St. George's' lights on the Pacific side. I do not know for certain how long this migration had been proceeding before the 'St. George's' arrival at Panama, or how long it lasted after my departure from Colon. It was a most remarkable sight, this steady stream, which to my knowledge lasted for three days, flying from west to east, and stretching over a width of more than forty miles at this narrow part of the isthmus. The only spectacle I have seen which in any way compares with it (though in a far less degree) was a flight of locusts in Morocco.

"*Urania fulgens* was first seen, though not plentifully, by members of the 'St. George' expedition on our arrival at Colon on June 9th, nearly three months previous to the date when the migratory flight was observed.

"On June 27th individuals were taken at light off the Pearl Islands, and between July 3rd and 12th a few were also seen flying by day at Gorgona Island, twenty-four miles from the Pacific Coast of Colombia."

Imported Coccids in Britain.—Mr. E. E. Green exhibited living specimens of the Fluted Scale (*Icerya purchasi* Mask.), found upon plants of *Pittosporum* in the greenhouse of a horticulturist in Derbyshire. The plants are said to have been imported from France, and the insect—in an early larval stage—was presumably introduced at the same time.

Mr. Green remarked that this was the first occasion upon which this notorious pest of Citrus trees had been taken alive in this country. In the present case, the insect had not merely existed in this country, but had attained to full maturity and had produced a vigorous second generation.

Mr. Green also showed, on behalf of Dr. R. Stewart MacDougall, an enlarged photograph of an African species of *Euphorbia*, from the Royal Botanic Gardens, Edinburgh.

The plant, which found its way into this country via the South African Court at the Wembley Exhibition, was heavily infested by the African Coccid, *Selenaspidus pumilus* Brain, a species that has not hitherto been recorded from the British Isles.

The presence of these two exotic species indicates the danger of an unrestricted importation of foreign plants, without proper precautions. Our various Colonies, and most foreign countries, have found it advisable to institute a system of inspection and quarantine, to check the introduction of alien insect pests. We, in this country, have relied upon the protection afforded by our climate, and this is usually effective in preventing the establishment of accidentally introduced species from warmer areas of the world. But, with the rise of Empire Exhibitions, elaborately staged with the flora appropriate to the various countries represented, we may conceivably find ourselves invaded by some insidious enemy capable of withstanding the discomforts of the British climate.

Finally, on behalf of Mr. Bainbrigge Fletcher, Imperial Entomologist of India, Mr. Green exhibited, on the lantern screen, a photograph of the large Indian Coccid—*Monophlebus octocaudatus*. The picture represented the stem of a cultivated peach tree, upon which the insects were thickly massed.

Mr. J. C. F. Fryer gave a short account of the measures adopted by the Ministry of Agriculture to prevent the introduction into the British Isles of Coccids and other noxious insects.

Mr. A. E. Tonge exhibited lantern slides of the ova of *Hibernia aurantiaria* laid in the empty eggshells of *Himera pennaria*, in the wild. The specimens had been found on Wimbledon Common by Mr. C. N. Hawkins on a birch trunk.

Mr. C. F. M. Swynnerton, who illustrated his remarks with numerous lantern slides, gave an interesting account of recent methods of controlling tsetse flies in East Africa.

In the discussion that followed Major E. E. Austen, D.S.O. (a visitor), and Dr. G. A. K. Marshall, C.M.G., F.R.S., commented on the great importance of the work that Mr. Swynnerton was doing and congratulated him on the results already attained.

Wednesday, March 18th, 1925.

Professor E. B. Poulton, F.R.S., President, in the Chair.

Election of Fellows.

The following were elected Fellows of the Society :—J. H. Ashworth, 151, St. Andrew's Road South, St. Anne's-on-Sea; Dr. W. Barnes, Decatur, Illinois, U.S.A.; C. J. Brooks, Woolpit, Suffolk; P. Haig Thomas, The Grange, Goring-on-Thames; F. Shaw, Ministry of Agriculture, Cairo, Egypt; K. M. Smith, M.Sc., Dept. of Agricultural Entomology, The University, Manchester.

Exhibitions.

The forms of Papilio dardanus Brown and its models from Marsabit, S.E. of Lake Rudolph.—The President said that owing to the kindness of his friend he was now able to exhibit examples of all the specimens referred to in Dr. V. G. L. van Someren's letter of September 12, 1923, quoted in Proc. Ent. Soc., 1924, pp. xxv, xxvi. The male was intermediate in pattern between *P. dardanus dardanus*, of Uganda, and *P. d. tibullus* Kirby, of the tropical East African coast, as shown by comparison with males from Uganda and Kibwezi, placed near it in the exhibition case. The Marsabit male, although much larger, resembled *P. d. polytrophus* from the Kikuyu Escarpment (see Dr. van Someren's letter. *ibid.*, p. xxvi), having a pattern which approached that of *P. d. dardanus* but the characteristic male armature of *tibullus*, as proved by Dr. Karl Jordan, who had kindly examined the specimen. The female form *cenea ochracea* Poult., and its model *Amauris lobengula septentrionis* Poult. (*ibid.*, pp. xxvi, xxvii) were again exhibited, together with *hippocoonoides* Haase, and *A. niavius dominicanus* Trim., thus completing the association so far as it is known at Marsabit. The *hippocoonoides* resembled the commonest female form of *P. d. tibullus* and its model the typical *dominicanus* of the east coast.

A letter received from Dr. Van Someren and dated February 20, 1925, stated that he had " just had the opportunity of

looking over a collection from Marsabit. There are *no* female *dardanus*, but plenty of the *Amauris l. septentrionis*. *No* Planemas and no Pseudacraeas. Isn't it unfortunate?"

Danaida chrysippus L., and D. dorippus Klug, bred from the same parent.—The President said that he had just received a letter, dated February 20, 1925, from Dr. V. G. L. van Someren stating that all the forms bred by him and referred to on p. cxxiii of the 1924 Proceedings "were of the same brood, the emergence of the two later insects (of September 9 and 10) being delayed. Some carry over for months." The Nairobi family, bred from a *dorippus* female, therefore consisted of 5 *dorippus* (4 ♂, 1 ♀) and 1 *chrysippus* (♀).

Mimetic association between Reduviid bugs and Carabid beetles in Kenya Colony and Uganda.—The President said that he had received the following account of an association observed by Dr. V. G. L. van Someren :—

Nairobi: February 21, 1924.—"During the last two weeks I had two collectors at a loose end (this being the off season for butterflies or larvae), so I sent them down the line to a place called Kiu in the Wakamba Reserve, to collect Coleoptera for our local Museum. The result has astonished me greatly—first of all as regards the quantity of things brought in, secondly the predominance of Carabidae, and thirdly the most striking number of examples of mimicry amongst them. I should think there are about 1500 Carabid beetles in the Collection, and roughly separating them out there are at least 38 species! There are several species which bear a close resemblance to each other; others which are good mimics of female Mutillidae, others of ants, and again others mimicking Tenebrionidae."

Another letter of May 1, 1924, drew attention to Reduviid mimics hitherto, it was believed, unrecorded—"there are many cases of bugs mimicking Carabids which interest me greatly. They are found together under stones and such-like."

The very interesting series exhibited to the meeting and represented on Plate A arrived safely, followed by a letter giving further details concerning the conditions under which the models and mimics lived :—

February 20, 1925.—"The passage in my letter of May 1,

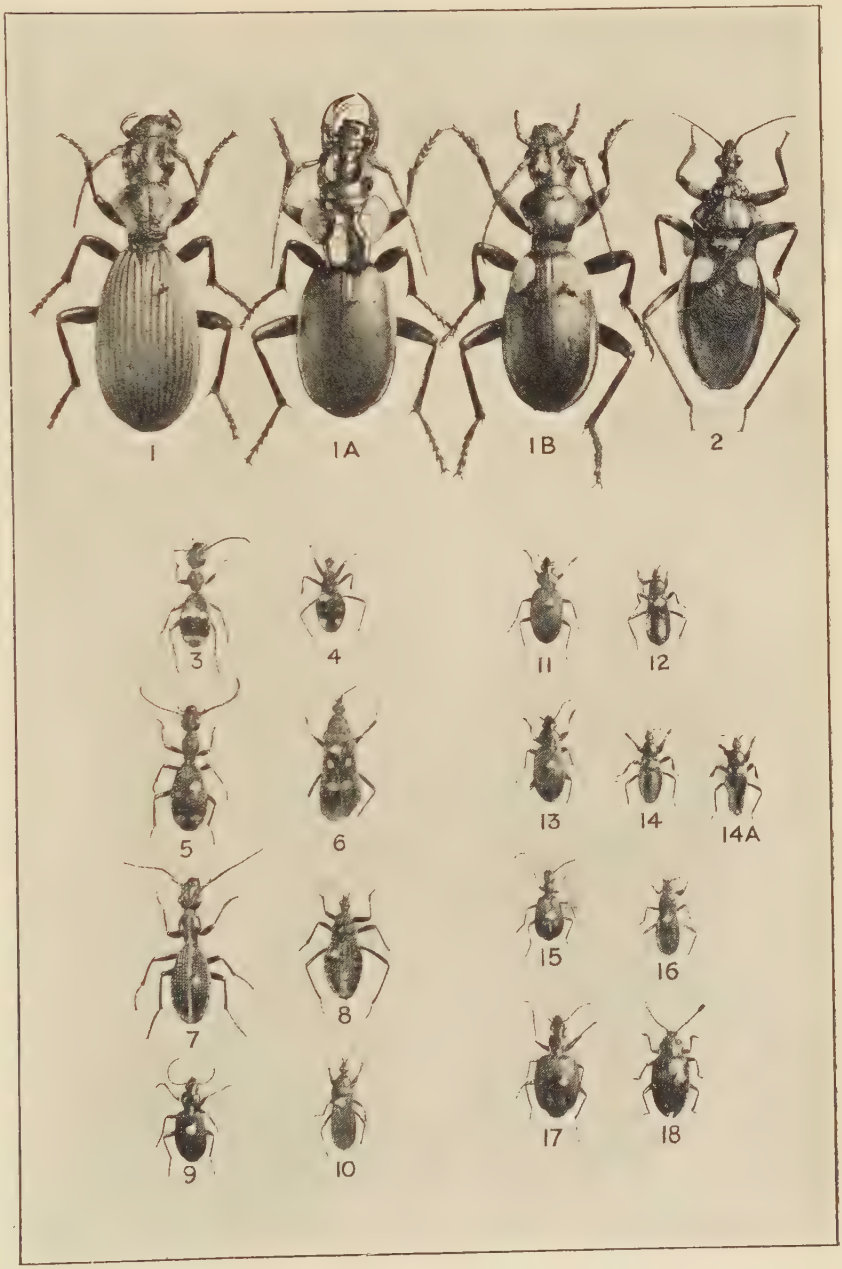
1924, just about describes the case. The insects are taken together under stones and débris such as decaying cut grass—vegetable débris thrown up along the banks of rivers and streams. There is a further common association—a small brown Carabid with a similarly coloured cockroach. There are heaps of these interesting things, but I've little time to collect them and make notes."

The Carabid models and their mimics received from Dr. van Someren are set forth in the tabular statement below, and are represented of the natural size on Plate A.

When neither locality nor date is mentioned in the table "Kiu : February 1924" is to be understood.

Carabid Models.	Reduviid Mimics.
Eccoptoptera cupricollis Chd.	*Edocla bisbisignata* Stål.
Polyhirma circulifera Fm.	*Ectomocoris quadrimaculatus* Serv.
Polyhirma divisa Boh. Archer's Post : June 1924.	*Acanthaspis vidua* Stål. Apterous ♀. Kiu : Febr. 1924.
Black Carabid, ? gen. and sp.	*Pirates lugubris* Stål.
Chlaenius fulvicollis Chd., var. *mimus* Pér. Nairobi : Febr. 1924.	*Pirates* sp. A. Larva. Nairobi : Febr. 1924.
Chlaenius ? *notabilis* Laf.	*Pirates* sp. B. 2 larvae.
Brachynus sp. Nairobi : April 1924.	*Phalantus africanus* Stål. Brachypterous ♀. Nairobi : April 1924.
	Endomychid Mimic.
Thyreopterus sp. Jinja : April 1924.	*Trycherus* sp. Mawakota : April 1924

It was of great interest, as showing the far-reaching complexity of these mimetic associations, that the Carabid model *Eccoptoptera cupricollis* (Pl. A., fig. 3) had been shown by Dr. G. A. K. Marshall, F.R.S., and by Dr. G. D. H. Carpenter



Alfred Robinson, Photo. *Vaus and Crampton.*

All the figures are natural size.

East African Carabid beetle models—odd numbers 1–17; with their mimics, Reduviid bugs—even numbers 2–16, and Endomychid beetle—18.

PLATE A.

All figures are of the natural size.

East African Carabid models with Hemipterous (Reduviidae) mimics and one Coleopterous (Endomychidae) mimic. The uneven numbers 1 to 17 represent the models, the even 2 to 18 the mimics.

The pale markings of insects 1 to 8 are dirty white, occasionally ochreous white, of 11 to 18 shades of burnt-sienna (orange brown): 9 and 10 are entirely black.

Fig. 1. *Anthia petersi* Kl. Salisbury, Mashonaland: G. A. K. Marshall: XI. 1898—I. 1899.

1A. *Anthia thoracica* F. Data as in 1.

1B. *Anthia mellyi* Brême. Data as in 1.

2. *Platymeris biguttatus* L. Kitgum, N. Prov., N. Uganda: H. F. Stoneham: January 25, 1923. This Reduviid bug is apparently a mimic of the Carabid pattern represented in the three previous figs., especially that of 1B.

3. *Eccoptoptera cupricollis* Chd. Kiu, Wakamba Reserve, Kenya Colony: collected for V. G. L. van Someren: February 1924. These data are to be understood for all succeeding figs. on this plate unless other data are mentioned.

4. *Edocla bisbisignata* Stål, apterous ♀. Mimic of 3.

5. *Polyhirma circulifera* Fm.

6. *Ectomocoris quadrimaculatus* Serv. Mimic of 5.

7. *Polyhirma divisa* Boh. Archer's Post, about 80 m. N. of Mt. Kenya: van Someren: June 1924.

8. *Acanthaspis vidua* Stål, apterous ♀. Kiu: van Someren: February 1924. Mimic of 7.

9. Carabidae: ? gen. and sp.

10. *Pirates lugubris* Stål. Mimic of 9.

11. *Chlaenius fulvicollis* Chd., var. *mimus* Pér. Nairobi, Kenya Colony: V. G. L. van Someren: February 1924.

12. *Pirates* sp. A, larva. Mimic of 11, and with the same data.

13. *Chlaenius* sp., ? *notabilis* Laf.

14, 14A. *Pirates* sp. B, larva. Two examples. Mimics of 13.

15. *Brachinus* sp. Nairobi: van Someren: April 1924.

16. *Phalantus africanus* Stål. Brachypterous ♀. Mimic of 15, and with the same data.

17. *Thyreopterus* sp. Jinja, Uganda: van Someren: April 1924.

18. *Trycherus* sp. Mawakota, about 20–50 m. W. of Kampala, Uganda: van Someren: April 1924. An Endomychid beetle mimicking a Carabid pattern of the type of 17.

PLATE B.

All figures are of the natural size.

East African Xylocopid (Hymenoptera. Aculeata) models with their Dipterous mimics (*Hyperechia*, Laphriinae. Asilidae). The left-hand figures represent the models; the right-hand the mimics.

The first models, 1 and 1A, with their mimic, 2, are entirely black; models and mimics 3 to 6 are black marked by posterior thoracic and anterior abdominal yellow bands; in mimic 8, the same species as 4, these bands are paler, probably influenced by the white-banded model 7, although the yellow-banded species 5 is common in the locality.

FIG. 1. *Xylocopa hottentotta* Smith, ♀. Nairobi, Kenya Colony, E. Africa: V. G. L. van Someren: March 1922. A model of 2.

1A. *Xylocopa* sp. ? *fraudulenta* Grib., ♀. Kaimosi, about 20 m. N. of Kisumu, N.E. Victoria Nyanza, Kenya Colony: van Someren: April 1922. Another model of 2.

2. *Hyperechia imitator* Grünb., ♂. Nairobi: van Someren: March 22, 1923. Mimic of black Xylocopids such as 1 and 1A.

3. *Xylocopa flavobicincta* Grib., ♀. Nairobi: van Someren: March 1922. This female (the male is very different) is the model for 4. *X. caffra*, ♀, shown in fig. 5, was not in Dr. van Someren's series. This, if it occurs at Nairobi, would provide a second model for 4.

4. *Hyperechia bifasciata* Grünb., ♀. Nairobi: van Someren: February 1923. Mimic of 3, and of 5 if it exists in the same locality.

5. *Xylocopa caffra* L., ♀. Willowmore, Cape Colony: Dr. H. Brauns. This female (the male is very different) is the model and also the prey (Trans. Ent. Soc., 1924, p. 126) of 6.

6. *Hyperechia nigripennis* Wied., ♀. Willowmore: Dr. Brauns: February 5, 1907. The mimic of 5; its larvae tunnelling in the same stems.

7. *Xylocopa inconstans* Smith, ♀. Kilosa, Tang. Terr.: A. Loveridge: March 31, 1921. The model of 8. Mr. Loveridge also considers that *X. nigrita* F. (Pl. C, fig. 5) and *caffra* L., ♀, act as accessory models (P.Z.S., 1923, p. 1014).

8. *Hyperechia bifasciata* Grünb., ♀. Kilosa: Loveridge: April 13, 1922. Resting four feet below nesting-holes of *X. nigrita* (ibid., p. 1014).

Alfred Robinson, Photo. *Vaus and Crampton.*

All the figures are natural size.

East African Xylocopid bee models—odd numbers 1–7; with their Asilid fly mimics (*Hyperechia*)—even numbers 2–8.

to be itself the mimic of a female Mutillid (Trans. Ent. Soc., 1902, pp. 511, 512, Pl. XVII, figs. 5, 11; Proc., 1918, p. xcviii); also that Carabidae, including species of the genus *Polyhirma*, some of them with patterns recalling those of figs. 5 and 7 on Plate A, were models for Cicindelidae,* and, as Dr. Marshall had pointed out, for Cleridae, the Carabidae being at the same time themselves mimics of female Mutillidae and in certain instances also of ants (*ibid.*, 1902, Pl. XVII, figs. 1–12, 14–19; *ibid.*, 1918, pp. xcvii, xcviii).

About the time that Dr. van Someren's Reduviids and their models were being arranged for exhibition a small collection of insects from Uganda was sent to the Hope Department by Capt. H. F. Stoneham, K.A.R. Among these was a large Reduviid bug, *Platymeris biguttata* L., (Pl. A, fig. 2) taken January 25, 1923 at Kitgum in N. Uganda. Capt. Stoneham wrote concerning it—"the large bug came to light and was caught by one of my native boys whom it pierced severely, causing a very painful and swollen finger for three days." Dr. van Someren's series at once suggested to Mr. Hamm that this Reduviid was a mimic of one or more of the large African Carabidae belonging to the genus *Anthia*, such as were shown in figs. 1, 1 A, and 1 B of Plate A and were originally represented in Trans. Ent. Soc., 1902, Pl. XVII, figs. 22, 23, and 26. Anthias with such patterns were widely distributed in Africa, as was the Reduviid *P. biguttata*. The patterns of the large Reduviid bugs in the allied subgenera *Platymeris* and *Pystala* were very similar, but there was much variation in the colour of the two conspicuous round spots. In some species these were red, in others orange, in others again yellow. It appeared probable that the pattern was essentially Reduviid and had only been modified by the change of the spots to white, a change which at once admitted the species into the *Anthia* association. A glance through the collection of Reduviidae in the British Museum showed the existence of many smaller white-spotted species of other genera, both Oriental and Ethiopian, which appeared

* Dr. Marshall also suggests that the posterior white spot or pair of spots on the elytra of the small and medium-sized Carabidae is probably directive, tending to ensure that a pursuing enemy will receive the anal discharge. In the Cicindelidae he interprets this feature as mimetic (Trans., 1902, pp. 510, 511).

to be mimics of medium-sized Carabidae bearing an *Anthia*-like pattern.

The Endomychid mimic (Pl. A, fig. 18) of a Carabid model (fig. 17), might be compared with Dr. Carpenter's Erotylid mimic *Mimodacne grandipennis* Fairm., found under the bark of a dead tree with its model *Thyreopterus flavosignatus* Dej., at Ndala (Proc., 1918, p. c). The patterns and colours of the two models and of the two mimics were very similar.

The Coleoptera on Plate A were kindly named by Mr. G. J. Arrow, and the Hemiptera by Mr. W. E. China.

Confirmation by Dr. Kunhi Kannan in S. India of Dr. V. G. L. van Someren's observations on Hyperechia and Xylocopa at Nairobi.—The President said that he had received the following interesting communication from Dr. K. Kunhi Kannan, M.A., Ph.D., Entomologist in the Dept. of Agriculture, Mysore State. He hoped that Dr. Kannan would send him specimens which could be determined and exhibited at a future meeting.

"*February* 5, 1925 : *Bangalore.*

"In regard to the relation between the larvae of the Asilid genus *Hyperechia* and those of *Xylocopa*, an article on which by you appears in the Transactions of the Entomological Society of London, 1924, Parts I and II, page 121, and in view, especially, of the ignorance of the Indian species of *Hyperechia* to which Mr. Cedric Dover draws attention in the same issue of the Journal, it may be of interest to bring to your notice that in August 1911, when examining a dead branch of *Eugenia jambolana* in which *Xylocopa* sp. ? *iridipennis* were breeding, *Hyperechia* larvae were also found. The association was just as described by Dr. van Someren. On a closer examination of the burrows, one *Xylocopa* larva was found sucked completely dry with the skin, however, milky-white and fresh, while beside it was a full-grown *Hyperechia* larva. The identity of the latter was only determined later when the flies were reared from the burrows. These observations were not published, as in the absence of literature at the time, it was believed that the habit was already on record. Both the mimic and model were, however, drawn in colour and have been

Alfred Robinson, Photo. *Vaus and Crampton.*

All the figures are natural size.

East African Xylocopid bee models—1, 3, 5; with their Asilid fly mimics (*Hyperechia*)—2, 2A, 4, 6, 6B.

shown ever since as examples of aggressive mimicry to the students of the Agricultural School connected with the Department of Agriculture, Mysore. It may also be recorded that in the same burrow a larva was found which was completely filled with small parasites probably belonging to the same species of Encyrtid referred to by Mr. Dover."

Some of the chief Asilid mimics with their Xylocopid models, from East Africa.—The President said that he thought it would be useful to illustrate by means of Plates B and C the striking examples of mimicry mentioned in Trans. Ent. Soc. 1924, pp. 121, 122, adding to them *Hyperechia marshalli* Aust., with its model *Xylocopa flavorufa* Deg., already represented in Trans. 1902, Pl. XXII, figs. 20 and 19 respectively. The names of the species with the conditions under which they were taken were sufficiently described in the explanation of the plate.

Copies of two beautiful coloured plates representing further examples of Dipterous mimics with their Aculeate models were exhibited to the meeting. These plates, kindly sent by Prof. E. Study of Bonn, showed three Asilid mimics, one Ortalid, and one Bombyliid.

Dr. G. D. H. Carpenter, D.M., on Pseudacraea eurytus L., and its models in Eastern Uganda.—A paper published under this title in the Transactions for 1923, p. 469, showed that in Eastern Uganda the female representative of the *hobleyi* group of this polymorphic species is of the orange and white form *poggeoides* Poulton, rather than the black and white form *tirikensis* Neave, which prevails further west. The apparent cause for this is the absence of models for *tirikensis*, namely the black and white females of *Planema macarista* E. M. Sharpe, and *Pl. alcinöe* Feld., race *camerunica* Auriv. The model for *poggeoides* is *Planema poggei*, race *nelsoni* Gr. Sm.

The collection from the Chawo Forest in Eastern Uganda, on the south bank of the Malaba River was, however, a small one; but on December 18, 1924, I obtained more specimens which give very strong support to the above conclusion.

Mr. A. O. Fisher, District Commissioner, kindly took me to a patch of dense bush near Busabi, about twenty miles

to the north of Chawo, where he had collected on December 14 two male *Planema poggei nelsoni*, and one female *Planema aganice* Hew., race *montana* Butler. On December 18 he captured two more males of *poggei* and I captured three. I also saw a pair *in copula* (the male supporting the female in flight), and a single male which, however, might have been one of those taken later in the day and so is better not added to the total.

The total number of *Planema* seen and captured was therefore 8 male and 1 female *poggei* and one female *aganice:* no other species of *Planema* was seen.

Unfortunately no *Pseudacraea eurytus* were seen, but it may safely be predicted that if Mr. Fisher meets with any they will be the male form *hobleyi* and the female form *poggeoides.*

It adds to the interest of the specimens that the form *planemoides* Trimen, of *Papilio dardanus* Brown, which mimics *poggei* was also taken (by myself) at the same time. Mr. Fisher had not seen this, but secured a single specimen of the form *hippocöon.* The three specimens of *poggei* and the *planemoides* which I caught are sent for exhibition, together with two specimens of a Hesperid * which I have not met before, whose strongly black-spotted pale under surface suggests a rough Acraeine mimicry. G. D. H. C.

The President brought forward the above communication and exhibited the accompanying specimens received from his friend at Entebbe.

The planemoides Trim., female form of Papilio dardanus and its model from the Mongalla Province of the Sudan.—The President exhibited an example of *planemoides* captured by Capt. A. L. Kent-Lemon on August 12, 1919 in the Khor Kanetti, near Imilla situated in 32° 35′ E. and 4° 12′ N., on the slopes of the Imatong Mountains. The Kanetti River flows about a mile to the west of Imilla. The specimen resembled many of the forms of *planemoides* from Uganda, the orange bar crossing the fore-wing being somewhat narrowed, especially towards the middle. Neither

* A species closely allied to *Baoris netopha* Hew., or more probably a geographical race of this species.

the male nor any other female was taken, although it was highly probable that the *hippocöon* female occurred, inasmuch as Capt. Kent-Lemon captured its model *Amauris niavius niavius* L. at Imilla. The model of *planemoides* was represented in his collection by a single female of *Planema poggei nelsoni* Gr.-Sm., taken on April 10, 1919, at Issurie in about 32° 42′ E. and 3° 55′ N., on the southern slopes of the Imatong Mountains, about 10 miles north of the Uganda border.

Mr. A. H. Hamm on the abnormally late emergence of Pyrameis atalanta L., at Oxford, in 1924.—On October 4, 1924, three larvae of *P. atalanta* were found each in its usual "tent," on Stinging Nettle, on the Old Road, near Shotover Hill, Oxford, and a week later three additional larvae and one pupa were obtained at the same place. The details of pupation and emergence were as follows :—

Larva found.	Pupated.	Emerged.
October 4	October 12	November 24, perfect.
,, 4	,, 15	December 5, a cripple.
,, 11	,, 16	November 29, ,,
,, 11	,, 16	December 2, perfect.
,, 4	,, 12;	failed to emerge.
,, 11;	failed to pupate.	

Pupa found October 11; failed to emerge, although colours of wings were visible.

The larvae and pupae were kept in the loft (without artificial heat) of the Hope Department, University Museum, in an endeavour to subject them as far as possible to natural conditions of temperature. The two perfect insects—both males—were after emergence kept in the same loft until they died. The first of these to emerge lived until December 8; the second until December 15. Four of the larvae were of the usual grey colour, but the other two were entirely black except for small yellow spiracular spots. All the pupae were without metallic lustre.

These results suggested that the very late specimens of *atalanta* that have been recorded as evidence of hibernation are the product of such delayed emergence.

A few larvae of *Plusia gamma* L., obtained at the same place and times as the above, also emerged late in November. No

details were kept, as they were required by Dr. Eltringham for dissection. Furthermore, several of them were parasitised by the Tachinid fly, *Phryxe vulgaris* Fall.

Forms of Colias from Peru.—Mr. G. Talbot exhibited the following forms of *Colias euxanthe* Feld., which appear to show dimorphism in both sexes.

A. Two yellow males and one yellow female from Puno, South Peru. One male agrees with the female in possessing a subapical series of four yellow spots, but they are smaller than in the female.

B. A white female from Puno. This is the form *weberbaueri* Strand, and differs from the yellow female of A in possessing three additional submarginal spots on the fore-wing.

C. A white male from Arequipa, Peru. This is the form *strandi* Röb.

D. A white male from Arequipa. This is larger than *strandi*, the fore-wing is more pointed, and the discoidal spot is larger. The colouring is lighter and more greenish than in *strandi*.

The exhibitor said: "In connection with these there exists another form similar to *strandi* but very much darker, and described by Fassl as *nigerrima*, from Bolivia, and Cuzco in S. Peru.

"It is not at present ascertained that the specimens mentioned belong to a single species, but there is a possibility that the white male D is another species. An examination of the valves does not show differences in any of the forms, but preparations were not made, the bodies being merely removed and softened. The specimens were all found to have their abdomen intact.

"The forms appear to occur on the Cordillera in the districts of Puno and Arequipa, and we have no data as to the altitude and time of appearance. The form *nigerrima* was said to occur at between 3600 and 4200 m.

"The specimens are in Mr. Joicey's collection at the Hill Museum, and I am indebted to him for being able to examine and exhibit them."

Wednesday, April 1st, 1925.

Mr. E. E. Green, Vice-President, in the Chair.

Election of Fellows.

The following were elected Fellows of the Society: -C. S. Elton, B.A., Dept. of Comparative Anatomy, University Museum, Oxford: D. J. Gordon, B.A., Craigellachie House, Strathpeffer; Chukichi Harukawa, Ohara Institute for Agricultural Research, Kurashiki, Okayama-Ken, Japan; R. T. Millott, Hill Crest, Carter Lane, Mansfield; H. W. Thompson, Advisory and Research Dept. in Agriculture, University College, Cardiff.

Exhibitions.

A silk-producing Lasiocampid Moth.—Dr. S. A. Neave exhibited some large colonial nests of a Lasiocampid moth, *Diapalpus congregarius* Strand, which had been sent to the Imperial Bureau of Entomology by Mr. A. H. Ritchie, Government Entomologist in Tanganyika Territory, and remarked that this appears to be the first Lasiocampid known to make colonial nests of this character from which silk is obtainable.

The Euploeas of Fiji: a correction.—The President, who was unable to be present, sent the following communication to be read to the meeting:—

"A recent note from Dr. G. Hulstaert, of Assche, Belgium, points out that *vadebra mangoensis* Butl., and *Euploea treitschkei jessica* Butl., both reported as Fijian, are not mentioned in my paper on the butterflies of these islands (Trans. Ent. Soc., 1923, p. 564). As regards *jessica*, Capt. N. D. Riley has kindly examined the series in the British Museum and informs me that the type only is labelled 'Fiji,' all the other specimens coming from the New Hebrides and New Caledonia. The series at Oxford is also New Hebridean. Butler's type (Lep. Exot., p. 20, pl. 8, fig. 3, 1869) is a male ('from Mr. Whitely'), in the collection of the late Mr. Herbert Druce, subsequently added to the Godman-Salvin collection. Fruhstorfer, in Seitz's 'Macrolepidoptera,' points out that *jessica* has never again been recorded from Fiji, and Capt. Riley agrees with

me that the locality label of the type is erroneous and that the species does not exist in these Pacific islands.

" *Vadebra mangoensis* (Butler, in Ann. Mag. N. H. (5), xiii, p. 344, 1884). As soon as I heard of this form I inferred that it was the E. Fijian race of *Euploea boisduvalii* which I had named *simmondsi*, and Capt. Riley informs me that my fears are well-grounded. The fact that *proserpina*, the W. Fijian race of the same species, had been placed in another genus, *Deragena*, put me off the scent. The type, the only example of the race as yet recorded from Mango, is unfortunately a female: it was collected by C. M. Woodford, July 15, 1882. Moore's genera were mainly founded on the secondary sexual characters of the male, and had the type been of this sex there is no doubt that Dr. Butler would have placed it in *Deragena* with the conspecific *proserpina*. Fruhstorfer treats *mangoensis* as a race of *climena*, his 'description' being 'a rare island race of rather smaller size.'

" I never had any doubt about the occurrence of the eastern race of *boisduvalii* in Mango and am glad to have this confirmation of the belief, although regretting that I had not noticed it before and that the subspecific name *simmondsi* should become a synonym.

" I wish again to thank Capt. Riley for his kind help at a time when I cannot consult collections or the literature of the subject.—E. B. P. *St. Helens, Isle of Wight, March* 31, 1925."

A MARINE CHIRONOMID FLY.—Mr. F. W. EDWARDS exhibited mounted specimens of a peculiar Chironomid fly taken by Dr. P. A. Buxton with a tow-net over the reef at Apia, Samoa. Dr. Buxton had suggested that the insect might be a truly marine form, and the probability of this being the case was borne out by various points in its structure. If this is established, it would seem to be the first known instance of an insect which spends its whole life in sea-water. Doubtless, as suggested by the collector, the early stages are spent in a water-plant which grows in the sandy part of the reef. Although the collector had apparently only noticed the males, females were present in the material sent, and these showed extraordinary differences from the males, being so reduced as to be little more than an egg-sac. The species does not

appear to be nearly related to the British *Clunio* and other known sea-breeding genera of Chironomidae; all these are air-living forms in the adult state. Dr. Buxton promises to investigate the matter more closely.

Henotesia perspicua Trimen [Lep. Satyridae] and its seasonal forms.—Mr. N. D. Riley exhibited a number of African Satyrids and said:—"*Henotesia perspicua* was described and figured by Trimen in 1873, from specimens obtained in Natal and St. Lucia Bay, S. Africa. The figure represents a fully ocellate (wet-season) specimen. The other species or forms which, rightly or wrongly, have been associated with *H. perspicua* by various authors, as seasonal variations, are: *simonsii* Butler (1877, June), *birsha* Hew. (1877, Oct.), *victorina* Westw. (1881), *maevius* Staud. (1887), *teratia* Karsch (1890) and *centralis* Auriv. (1903).

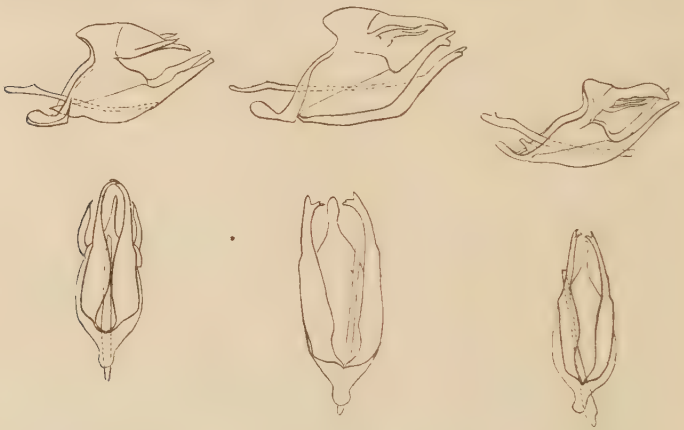
"The first reference to seasonal variation in *H. perspicua* is made by Barker in the Trans. Ent. Soc. 1895, p. 414, but he does not associate with it any of the other named forms. The next year, however, Marshall (*l.c.* 1896, p. 562) gave it as his opinion that *simonsii* Butler was the dry-season form of *perspicua* Trimen, and called attention to the close connection between the two forms, already noted by Trimen. With this view Butler (P.Z.S., 1896, p. 822 and 1897, p. 50) agreed. Aurivillius, however, in 'Rhopalocera Aethiopica' expressed some doubt as to the correctness of the assumption, treated *simonsii* as a distinct species and *maevius* Staud. as the dry form of *perspicua*. And this view he maintained in 1911 when dealing with the genus *Henotesia* in the African section of Seitz's 'Macrolepidoptera of the World,' in spite of the further support given to Marshall's opinion by Neave in 1910 (P.Z.S., p. 10).

"In 1921 I expressed the opinion (Trans. Ent. Soc., 1921, p. 241) that not only were *perspicua* and *simonsi* seasonal forms of the same species, but that *birsha* and *teratia* also were forms of the same species; the former being an extreme wet form, the latter intermediate between *perspicua* and *simonsi*—the whole forming a beautifully graded series. I based this opinion on the long series of dated specimens in the British Museum. Had reference been made to the ♂

genitalia for confirmation, as has since been done, a very different conclusion would have been reached; for the actual relationship of the five forms, based on an examination of these structures, shows that there really are three species: –

(1) *simonsii* Butler, with wet form *birsha* Hew.;
(2) *teratii* Karsch;
(3) *perspicua* Trimen, with dry form *maevius* Staud.

"Aurivillius was therefore right in refusing to associate *simonsi* with *perspicua*; but, on the other hand, he failed to recognise that *birsha* was the wet form of *simonsii*. This is



perspicua *simonsii* *teratia*

perhaps not surprising when one remembers that *simonsi* and *birsha* are the extremes in opposite directions of the five forms under consideration.

"Incidentally this solution of the question disposes of several difficulties which the *perspicua-simonsi* combination did not overcome. Dr. Marshall recently told me that he never could understand why the dry *simonsi* did not occur in Natal, although its supposed wet form, *perspicua*, was common enough there; the explanation is simple when it is remembered that *simonsi* and *perspicua* are distinct species having dissimilar distributions. Neave in his account of the butterflies of Northern Rhodesia mentions that he found 'typical *simonsii* only in the very hot and dry river-valleys of the Luangwa and the lower Lofu

near Lake Tanganyika. On the high plateau generally of N.E. Rhodesia and throughout Katanga the extreme dry-season specimens are somewhat intermediate between *perspicua* and *simonsi*.' These high-plateau specimens are neither *perspicua* nor *simonsi*, but *teratia* Karsch. And again Dollman in his MS. notes on the butterflies of N.W. Rhodesia, mentions that *birsha* and *simonsi* occurred at Mwengwa, but not at Solwezi, the opposite being the case with *perspicua*, and concluded that the Mwengwa *simonsi* were therefore probably seasonal forms of *birsha*—a conclusion in which, as it ultimately transpires, he was perfectly correct.

" Male genitalia. In general outline all three species are very similar. *Teratia* and *simonsi* agree in the relative length of the lateral processes of the uncus (falces), but the median process is much larger in relation to the rest of the uncus, and stouter, in *teratia* than in *simonsi*. In these two species the tips of the claspers are divided, and the claspers generally are much alike, but more slender, especially distally, and with finer distal lobes in *teratia* than in *simonsi*. In *perspicua* the falces are broad and straight, projecting above the uncus and nearly as long as the median portion; the claspers not divided apically, stout at about $\frac{1}{3}$rd from their bases, thence tapering evenly and with their tips curved towards the median line."

Seasonal forms of Polyommatus icarus from Palestine. —Mr. P. P. Graves exhibited specimens of *Polyommatus icarus* from Palestine showing that in the vernal generation, even from the hottest localities, the blue-green suffusion at the bases of all wings on the underside was as strongly marked as in specimens from Northern localities, and that blue-suffused females occurred, even at Jericho. For purposes of comparison he also exhibited specimens of an apparently single brooded race of *P. icarus* from great heights (6,000–10,000 feet) on Mount Lebanon presenting certain singular features, *e.g.* more elongated wings, thinner scaling, diminution of underside marking and large size, which has not yet been named. He also exhibited specimens of the European race (*thracicus* Buresch) of *Archon apollinaris* and narrated the circumstances of its discovery in 1913 by King Ferdinand

and Dr. Buresch in Thrace, and finally showed a very variable series of *Melitaea didyma* of the second generation from various localities near Constantinople.

The types of the Ithomiine butterflies Melinaea mneme Linn., and M. crameri Godm.—Mr. W. J. Kaye exhibited specimens of *Melinaea mneme* L., and *Melinaea crameri* Godm., and read the following note on these two species.

Linnaeus described *Melinaea mneme* in his Syst. Nat., I, 2, p. 756, n. 59 (1767). His description was so short that it was found in later years to answer for two distinct species. Weymer in 1890 still considered there was only one species; but actually knew the insect figured in Cramer, Pap. Ex., II, t. 190 fig. C (1779), and in Herbst. Natursyst., Pl. 69, fig. 7 (1790), to which he refers in a paper in the Stett. Ent. Zeit., 1890, p. 282. He erroneously referred Cramer's figure of "*mneme*" as the correct type of the species. The type of Linne's *mneme* is still in existence in his collection in the rooms of the Linnaean Society at Burlington House, and is not the species assigned by Weymer, but the species as correctly placed by the late Dr. Godman. In the Trans. Ent. Soc. for 1898, p. 107, Godman described the "*mneme*" of Cramer as *crameri*, and the matter was straightened out till the appearance in Seitz, Macrolep., V, p. 123, Pl. 33*a*, of *mneme* being identified as *crameri*, which latter is treated as a synonym of *mneme* with true *mneme* treated as *mediatrix* Weym. Weymer in 1890 considered there were three forms of *mneme*:—

(1) *mneme* typical (= *crameri* Godm.);
(2) *mneme* var. *mediatrix* (= true *mneme* Linn.);
(3) *mneme* var. *mauensis* Weymer (Stgr. in litt.).

As Linnaeus has left his type of *mneme* with his own handwriting on the specimen, there should never again be any confusion. There are two specimens in Linnaeus' collection of the same form of *mneme*, the upper one having the label name *mneme*.

The synonymy of the two species can be tabulated as follows:

1. *Papilio mneme* Linn., Syst. Nat., I, 2, p. 756, n. 59 (1767). Herbst. Natursyst., Pl. 70, fig. 1 (1790).

Melinaea mneme Godm., Ent. Mo. Mag., IX, p. 221 n. 55 (1871).
Melinaea mneme var. *mediatrix* Weym., Stett. Ent. Zeit. (1890), p. 282.
Melinaea mneme var. *mavensis* Weym. *l.c.* p. 283 (Stgr. in litt.).
Melinaea mediatrix Haensch in Seitz, Macrolep., V, p. 123, Pl. 33*b*.
Melinaea mediatrix mavensis Haensch, *l.c.*
Melinaea mediatrix ab. *anina* Haensch, *l.c.*
Melinaea mneme Kaye, Trans. Ent. Soc. Lond., 1907, p. 417, Pl. XXIII, fig. 7.
2 *Papilio mneme* Cramer (nec Linn.), Pap. Exot., II, t. 180, fig. C (1779). Herbst. Natursyst., Pl. 69, fig. 7 (1790).
Melinaea mneme Weym., Stett. Ent. Zeit. (1890), p. 282 (first form).
Melinaea crameri Godm., Trans. Ent. Soc. Lond., 1898, p. 107. Kaye, Trans. Ent. Soc. Lond., 1907, p. 418, Pl. XXIII, fig. 6.
Melinaea mneme Haensch (nec Linn.) in Seitz, "Macrolep.," V, p. 123, Pl. 33*a*.

A banded form of *Melinaea crameri* corresponding to the banded form of *M. mneme* is apparently undescribed. It is quite a rare form for which I propose the name

Melinaea crameri ab. *incisa* **ab. nov.**

Forewing like typical *M. crameri*. Hindwing with the black area completely divided by a band of the reddish-ochreous ground-colour at two-thirds the distance from base.

Habitat. British Guiana, Essequibo Riv.

Commander J. J. Walker, R.N., read a letter from Mr. C. L. Collenette describing the visit of the steam yacht "St. George" to the Marquesas and other islands in the Pacific.

Papers.

The following papers were read:—

1. "On the Abdominal Scent-glands in *Heliconius*," by Dr. H. Eltringham.

2. "On the Ocellus in *Pieris rapae*," by Dr. H. Eltringham.

3. "A Revision of the Genus *Artitropa* (Hesperidae)," by Mr. N. D. Riley.

4. "On the Dispersal of Insects to Spitsbergen," by Mr. C. S. Elton.

5. "New Geometridae from Madagascar," by Mr. L. B. Prout.

Wednesday, May 6th, 1925.

Prof. E. B. Poulton, F.R.S., President, in the Chair.

Election of Fellows.

The following were elected Fellows of the Society:—W. S. Gilles, F.I.C., F.C.S., The Cottage, Bocking, Braintree, Essex; E. Marks, 20*a*, Motcombe Street, Belgrave Square, S.W. 1.

Wicken Fen.

Mr. Sheldon made an appeal on behalf of the Wicken Fen Fund, and stated that Mr. A. Robinson had become a member of the local Committee.

Dinner.

The President announced that a dinner would be held on the first Tuesday in October to celebrate the fact that the Debentures were all paid off, and that the Society's Housing Fund was free from debt.

Exhibitions.

A series of Thera variata var. britannica.—Mr. H. J. Turner exhibited a variable bred series of the race *britannica* of *Thera variata* sent to him by Mr. W. Fassnidge of Southampton, who obtained them from that neighbourhood; they were quite of the same form as those bred last year and shown at a previous meeting, and distinctly separable from the typical continental race from the neighbourhood of Vienna.

Insects from Bordighera.—Mr. H. Donisthorpe exhibited a number of insects of many orders taken by him in Bordighera in January, February, and March this year; and made remarks on the district and the habits of many of the insects found there.

Scents in Canadian Butterflies.—Dr. F. A. Dixey exhibited some butterflies captured during his recent visit to Canada, and contributed some observations which he had been able to make on their scents when in the fresh condition. The specimens exhibited were in every case actual individuals that had been tested. The species were as follows :—

G. rapae Linn. Of 8 males examined, all had the sweet-briar scent; this was distinct in 5, faint in 3. No scent was found in any of the 3 females tested.

S. protodice Boisd. A female had no scent, but a slight flowery fragrance was suspected in the only male examined.

C. philodice Godt. Five males gave a somewhat doubtful result, but in two of them a faint smell like hay was more than suspected.

T. euterpe Mén. The only female caught was odourless. No opportunity occurred of examining the male.

S. eurydice Linn. The scent of a male specimen was very distinct. It was rather disagreeable, suggesting privet, with a touch of spice. A female was quite odourless.

C. nephele Kirby. Of 6 males of this Satyrid, 3 had a scent, not very strong, like cedarwood with a touch of spice. In the other 3 the scent, if present, was very faint.

A. atlantis Edw. Both sexes of this Fritillary were found to be scented. The male examined had an odour which suggested old hay in a cigar box. The female had a scent which might be described as " warm " and spicy; it appeared to be different from that of the male.

A. eurynome Edw. A male specimen of this Fritillary had a strong, sweetish, spicy, fragrant smell, reminding one of sandalwood. No female specimen was examined.

D. archippus Fabr. (*plexippus* auct.). The testing of this butterfly gave a rather unexpected result. Of 7 males, every one had a strong, sweet, flowery scent, like that of roses; with a suggestion of something " rougher " or " spicier." Of 4 females, 3 were scented, the fourth gave a doubtful result. In this sex there was a sweet scent at first, followed and overpowered by a rather musty scent like that of old upholstery. The scent of the male appeared to be absent.

Dr. Dixey further remarked that of species whose scents

had been investigated before, the *G. rapae* appeared to be less strongly scented than those examined by him in the Canary Islands (Proc. Ent. Soc. Lond. 1922, p. lxxiii). Dr. Longstaff had found that the female of *T. euterpe* was scentless, though 31 out of 39 males gave a decided odour ("Butterfly Hunting in Many Lands," 1912, p. 509). The same observer remarked on the scent in *Colias* that "its volume, if one might use the expression, seems to be very restricted, requiring the keenest sense for its appreciation." With regard to *D. archippus*, the results obtained by Dr. Longstaff appeared to diverge widely from those just recorded by the exhibitor (*ibid.*, p. 495). In one respect, however, they agree, and the following words, cited from Dr. Longstaff's description, may possibly go some way towards accounting for the difference:—"It is quite certain that in some butterflies two quite distinct scents may be detected in the same individual, one transient, the other more persistent; it is not improbable that herein may be found the explanation of some apparent exceptions, or discrepancies" (*ibid.*, p. 493).

Notes on the life-history of Calopieris eulimine Klug, in the neighbourhood of Port Sûdân.—The following notes on this little-known butterfly,* by Mrs. E. M. Waterfield, were communicated by the President.

Calopieris eulimine Klug.

This insect is common on the Red Sea littoral, extending, in my experience, from Agig to Donganab and inland as far as Sinkat, wherever its food-plant *Capparis aphylla* Roth., is found.

C. aphylla is also one of the food-plants of *Belenois mesentina* which is always more abundant than *C. eulimine*, and it is easy to overlook the smaller butterfly in the cloud of "Whites" that one may put up from this bush during the short butterfly season, which generally lasts from January to March.

C. eulimine is a short-legged, rather weak-flying butterfly. I have never taken it far from its food-plant, and it does not appear ever to visit other flowers or bushes. The male is

* See Dr. G. B. Longstaff's beautiful figures of this species in "Butterfly Hunting in Many Lands" (London, 1912), Pl. V, figs. 1, 2; also pp. 407, 414, and 422, and his paper in Trans. Ent. Soc. 1913, pp. 32, 33.

considerably commoner than the female, about four or five males to one female being the proportion in which I have taken it, but this may be partly due to the fact that the female is harder to find, as she is frequently seen fluttering about inside the jungle of sticks which constitute the food-plant, looking for young leaves on which to lay her eggs. At dry seasons of the year the young shoots are almost non-existent, but after rain the plant makes vigorous growth and it is then that the *Calopieris* is most abundant.

The egg, which is small and green when fresh, is laid singly, on the tips of the young shoots or flower-buds. After a few days it turns yellow, nearly matching in colour the thorns of the plant. In captivity the egg hatches in from 7 to 9 days, the larva eating its way out at the tip and leaving the empty shell to all appearances intact upon the shoot. The larva is yellowish-green in its first stage, and slowly works its way off the young shoot on to the older and greener wood of the bush. After the first moult it turns green, very closely matching the colour of its food-plant. The larva can now be seen to be smooth, but with a very slightly downy appearance. The head is flat and green, outlined in stone-colour. The underside of the caterpillar is somewhat concave and the claspers, which are short, are invisible, being concealed behind the sides which fit closely to the twig on which the larva rests.

The caterpillar is slim and the body ends in two short tails. It generally stretches itself along a twig with the head at the fork of a side shoot. In captivity it became full-fed in from 16 to 18 days, when it measured about $1\frac{1}{4}$ inches. In one or two examples that I bred, 6 or 8 paler green lozenge-shaped markings appeared on the side of the caterpillar before pupation. In all cases the colour changed to a mottled brown during the last 48 hours of larval life.

The chrysalis is fastened to a twig by its tail and also by a silken girdle round the wing-cases. The head may be either upwards or downwards. The pupal state lasts for about 16 to 18 days, and during the last 24 hours the colour of the wings is clearly visible through the wing-cases. The underside of the chrysalis is slightly rounded to fit the twig.

I have never been able to find the caterpillar on its food-

plant, but it is by no means hard to find the single egg on the tips of the young twigs. Care must be taken not to collect empty egg-shells, nor to mistake the large yellow eggs of *P. mesentina*, in clusters on the young twigs, for those of *Calopieris*.

Mr. C. B. Williams exhibited a drawing of a Nemopterid larva found in the Wady Digla, near Cairo, Egypt. This differs from the species previously found (*Pterocroce storeyi*, Trans. Ent. Soc., 1923, p. 277) in having a much shorter neck, and is either another species of Crocinae, or perhaps that of a dayflying species of *Halter* the adult of which is not uncommon in the locality. Should the latter prove to be true when the adult emerges, it will be the first full-grown larva of the subfamily Nemopterinae yet known.

Dr. E. Handschin of Basle University, who illustrated his remarks with lantern slides, gave an account of the insect life of the high Alpine snows.

Papers.

The following papers were read :—

1. "On the scent-sacs in the Genus *Rhodogastria*," by Mr. G. T. Bethune-Baker.

2. "On the wing-coupling apparatus of Hepialidae," by Mr. A. Philpott.

Wednesday, June 3rd, 1925.

Prof. E. B. Poulton, F.R.S., President, in the Chair.

Obituary.

The President announced the deaths of Prof. B. Grassi, Honorary Fellow, and of Dr. A. G. Butler, Fellow of the Society.

Election of an Honorary Fellow.

The President announced that Prof. R. Gestro of Genoa had been elected an Honorary Fellow of the Society.

Election of Fellows.

The following were elected Fellows of the Society :—F. F.

Laidlaw, M.A., M.R.C.S., L.R.C.P., Hyefield, Uffculme, Devon; J. H. Leak, 73, Pershore Road South, King's Norton, Birmingham; John Levick, Handsworth Wood, Birmingham.

Exhibitions.

A male of Pteronus similis.—The Rev. F. D. Morice showed a ♂ and ♀ of *Pteronus* (*Lophyrus*) *similis* Hartig, which he had bred—the ♂ on May 14 of this year and the ♀ a month earlier (April 14)—from larvae sent to him alive on Oct. 23, 1924, by Mr. E. E. Green, who had beaten them from Weymouth Pine (*Pinus strobus*) at Camberley.

He said that this was one of two species of sawfly to which he had called attention at a previous meeting of the Society (Nov. 5, 1924) as not previously recorded from Britain, though one of them (*Pteronidea spiraeae* Zadd.) had for many years been more abundant than welcome in British gardens (certainly in Hertfordshire, Surrey, and Hampshire, and probably elsewhere) which contain its special food-plant, the "*Spiraea aruncus*" of florists and of Linné, but now (he believed) called by botanists "*Aruncus aruncus*" or "*Aruncus silvester*"; while the other had occurred from time to time flying among conifers in several very widely separated British localities (Sutherland, Kent, Surrey, and the New Forest). This latter was the species of which he now showed specimens, and the ♂ (so far as he knew) was the first specimen of that sex that had been captured or bred in Britain, though it might perhaps be standing under some other name in collections not yet seen by him.

Immediately after the emergence of the ♀ from the cocoon—which was also exhibited—she was placed in a tumbler covered by a glass "quarter-plate," and provided day by day with bunches of needles from *Pinus strobus*. On these she laid quite a number of eggs at intervals during the time—about 5 days—through which she lived after leaving the cocoon. Most of them, through various causes, came to nothing; but a certain number produced larvae in about a fortnight, and of these 5 became nearly full-grown. One of the 5 then died for some unknown reason, but the other 4 duly spun up—on May 24, May 30, May 31, and June 1 respectively, and are

now in that condition. (The first of the cocoons to be completed was exhibited as well as that of its parent.)

These eggs were, of course, all parthenogenetic, the mother never having seen a ♂. They were laid, generally 5, 6, or more at a time, in a row along one side of a needle and nearly touching each other, but sometimes by twos or threes, or even singly, and immediately covered by a clammy greenish substance probably derived from the laceration of the needle by the saws of the parent, which after a time changed its colour to a brownish yellow, and seemed to harden. If, which did not always happen, the needle on which the eggs were laid remained green and fresh, the eggs gradually increased in size—more rapidly (as it seemed) in *breadth* than in length—and in so doing burst through their brownish covering, which fell away in flakes leaving the eggs more or less completely exposed. If, however, the needle withered and dried up, the eggs presumably perished also: at any rate they grew no more, and the dried secretion remained in place permanently. The colour of the eggs when they became visible was a distinct though very pale blue.

The first larvae appeared on April 28. They were then, of course, very small, and appeared to be entirely dark green with black heads and no pale or yellow markings. They grew very slowly, and many of them died before assuming the characteristic coloration of the adult—namely, a long whitish vitta in the middle of the dorsum, which was bisected longitudinally by a dark blackish line, below this vitta on each side appeared a close succession of parallel transverse whitish yellow streaks, and below this again a series of roundish spots the largest of which were always bright yellow while the smaller ones were sometimes yellow and sometimes whitish. The ground-colour of the body apart from these markings was plumbeous-black, the head and thoracic legs entirely shining black, the ventral and caudal prolegs and the whole thoracic and abdominal ventral surface (between the legs and prolegs) clear white.

The young larvae often fed *in pairs*, one on each side of a needle, so that their ventral sides were almost in actual contact (!). They ate at the same rate, always moving *backwards*

as they did so. Of course, if they had done otherwise, they would have eaten away the part of the needle which supported them and tumbled sooner or later to the ground. Though thus careful of their own safety, they had no consideration for that of their brethren or sisters. Often the first larva that emerged from a batch of 6 or more eggs would begin feeding between the eggs and the base of the needle, causing the latter before long to dry up, and the eggs thus cut off from nutriment to perish without producing larvae. In this case the brown covering remained *in situ*, and the exhibitor had photographed such needles, many weeks after the eggs had perished, which were quite unaltered from their appearance a few days after the oviposition.

Such specimens as survived till they were nearly full-fed, did not (like many sawfly larvae) assume a threatening attitude by throwing up the hind part of the abdomen when shaken or alarmed, but reared up, tossing the head backwards, projecting their thoracic legs forwards like the fists of a pugilist, and holding on to the needle by their ventral and caudal prolegs only. Finally, one after another, they spun up near the leaf-bud in the centre of a bunch of needles. The cocoons were at first quite white and translucent, the movements and colours of the larvae more or less distinctly visible inside it. Afterwards, as they became thickened by the growth of an opaque inner layer, they became pale-brown and singularly resembled both in form and colour the leaf-buds beside which they had been placed.

Species of Anthicus from Bordighera.—Mr. H. Donisthorpe exhibited specimens of *Anthicus 4-guttatus* Rossi., and *A. rodriguesi* Latr., taken in a nest of *Messor structor* Latr., at Bordighera 1.ii.25; *A. longicollis* Schmidt, taken in a nest of *Formica fusca* L., at Dolceacqua 6.iii.25; and *Formicomus pedestris* taken with *Colobopsis truncatus* Spin. and *Cremastogaster scutellaris* Ol., at Kew in May 1909.

He also mentioned that he had taken the larva of an *Anthicus* in a nest of *Pheidole pallidula* Nyl., at Bordighera on Feb. 11, 1925.

Mr. Donisthorpe made remarks to show that first of all the Anthicidae obtained protection from their ant-like appear-

ance, secondly that some showed actual mimicry of the host with which they occurred, and thirdly that many more were truly myrmecophilous, or were on the way to become so, than was generally believed.

A new Aegeriid mimicking a wasp.—Lord Rothschild exhibited a new mimetic Aegeriid from the Philippines which he is describing under the name of *Trilochana triscoliopsis*; together with its model *Triscolia whiteheadi* Burgh. He remarked that apparently only the ♂ Scoliid wasps were mimicked as in the other five species of the genus *Trilochana*, the two whose model was known also mimic only ♂♂ of the Scoliids. He thought that this was due to the ♀♀ being less in evidence.

Wasps of the same species with transparent and with dark wings taken from the same nest in N. Uganda.—The President exhibited six females of *Belonogaster juncea* F. —two clear-winged and four dark-blue-winged. All were taken from one nest by Capt. H. F. Stoneham, K.A.R., on August 17, 1924, at Kwadiek, about five miles north of Kachung on Lake Kwania, ninety-seven miles south of Kitgum, in northern Uganda. The British Museum series of this common African wasp contained both forms, but it was believed that Capt. Stoneham's evidence that they may exist in the same community was the first that had been obtained. It was possible that the difference was due to the greater maturity of the dark-winged forms, but this was a mere suggestion which could easily be tested by keeping the clear-winged wasps in captivity for a time. Mr. B. Uvarov had kindly determined the species.

The egg and pupa-case of Calopieris eulimine Klug, bred by Mrs. E. M. Waterfield at Port Sûdân.—These specimens, kindly sent by Mrs. Waterfield, were exhibited by the President in illustration of the notes on the life-history of this species communicated to the previous meeting.

Notes by G. F. Leigh on the larval habits of Anaphe panda Boisd., the "Processional moth."—The President, in communicating Mr. Leigh's notes, said that neither Mr. W. H. T. Tams nor Dr. G. A. K. Marshall had been able to

find any record of the processionary habits of these larvae, except the following brief statement by Col. J. H. Bowker, who, writing from Durban to Lord Walsingham on July 4, 1885, said that the larvae "move in a body, sometimes ten or even twenty yards long, in search of 'pastures new,' and when the time comes, form into a cluster, and form the nest covered with a brown silk." Lord Walsingham also observed that "bodies of from twenty to forty [larvae] constantly came out [from the nest sent by Col. Bowker] and moved about, always keeping close to it. They moved in a closely packed mass, following a slightly curved line. . . ." (Trans. Linn. Soc., Lond., Ser. 2, Zool., Vol. II, pt. 12, 1885, p. 421.)

The following account by Mr. G. F. Leigh therefore threw much additional light on the habits of these interesting caterpillars.

"I am writing a description of the habits of the larva of the above moth from which it has received here the name of the 'Processional Moth.' The female lays her eggs in a bunch upon the trunk or branch of the tree the larva feeds upon, and covers them over with the scales composing the tuft upon her abdomen. The young larvae mount the tree and feed in company for a time. When about half grown they come down in the morning, and at night or rather dusk one of them constitutes itself as leader, which they all follow in a line, the head of each one to the tail of the one in front. They never form two lines, and I have sometimes seen them winding like a rope round the trunk; for often the leader does not mount the tree by the shortest route. Furthermore, it sometimes decides to go to a different tree, and in such cases I have seen them in procession on the ground, or even travelling across the railway line, for example on the South Coast Line not far from Lower Umkomaas, about 31 miles from Durban. On this occasion all the larvae passed over in safety.

"When full-fed the larvae mount the tree for the last time, and form a single huge cocoon which they fix to one of the branches. Each larva, however, makes a separate cocoon for itself within the large one, and they remain for a long time in the larval state in their cocoons, before changing to

pupae. I opened one about three weeks after I had taken the large cocoon and found it still contained a larva, although hairless and nearly pink in colour. The larva closed up its opened cocoon on the same day. The larvae, owing to their habits, are terribly parasitised. In one instance I only succeeded in rearing 37 moths from at least 100 caterpillars.

" Geo. F. Leigh.

" Durban, Natal.

" January 22, 1925."

Dr. V. G. L. van Someren on butterflies and a moth captured for their young by flycatchers at Nairobi, and the insects found in the crop of a Marabout stork shot in the Nairobi district.—The President exhibited the wings of the male and female *Papilio dardanus* Brown, and of the Noctuine moth *Serrodes partita* F., taken by the flycatchers, together with examples of the two Mylabrid beetles *Zonabris aperta* Gerst., and *Epicauta nyassensis* Haag, the Acridian *Lobosoma ambages* Karsch, and the Noctuid moth *Spodoptera abyssinia* Guen. (Acronyctinae) with its larva, from the crop of the Marabout stork. The moths had been kindly determined by Mr. W. H. T. Tams, the beetles by Mr. K. G. Blair and the Acridian by Mr. B. Uvarov.

Dr. van Someren's interesting notes are recorded below :—

" *March* 26, 1925.—A pair of flycatchers (*Tchitrea*) nested just outside one of my study windows. They raised two young, and the parents fed their chicks most assiduously throughout the whole day. The young birds remained on the nest tree for several days after they had left the nest and could fly. They were fed largely on moths of various species, which were *very abundant* at this time.

" Having some odd live *dardanus* handy I thought I would try a little experiment. I first took a male and, waiting a favourable opportunity when the parent flycatchers were within view, threw the live butterfly out of the window. At once the male parent swooped down and captured the insect, beat and snapped off the wings and legs and fed it to one of the young birds. I next tempted the female parent with a full *cenea* female. She snapped it up at once without the

slightest hesitation, treated it as did the male bird with the male *dardanus* and fed it to a young bird, who accepted it eagerly. The moth, whose wings I send, was as readily accepted by both parent and young. Was it merely the stress of providing sufficient food for the young which made the parents snap up this fully mimetic *Papilio*, or was it that the female flycatcher had not learnt the distasteful properties of the *Papilio's* model and the association of colour and pattern therewith? The *Amauris* appears more frequently in my garden than does the *Papilio*, but both are infrequent visitors.

"Another observation. The other day I came into possession of a Marabout stork which had been shot not far from Nairobi. The bird was skinned and mounted, and as usual I investigated the contents of the crop and stomach. The latter contained a green liquid; the former was quite full of lepidopterous larvae, a few beetles, and some grasshoppers. The beetles interested me because they belonged to two species —of *Mylabris*—both surely distasteful! The caterpillars interested me to an even greater extent, for all were of an abundant species of grass-feeding moth. During the many years that I have resided out here I have never seen a bird attacking these larvae. When the season is favourable they simply swarm in millions over the grass country, in some districts devouring every blade of grass over many acres. They sometimes do vast damage to sprouting maize. Occasionally they move from one locality to another in a huge, wide procession, and at such times they even hold up traffic on road or rail if such happens to be in their line of migration. The surfaces of either become so slippery with the juices from their crushed bodies that motors skid and the wheels of the engines won't grip on the rails! This Marabout had no less than 515 larvae in her crop!

"I send a specimen of the moth and larva, also the Mylabrids, for identification. The Marabout is protected out here, and this additional evidence of its economic value should strengthen the case for its protection."

The President said that the observations illustrated by the exhibit were of much interest, throwing light upon Mr. C. F. M.

Swynnerton's conclusion that insect-eating birds when very hungry would seize the largest prey at hand, irrespective of palatability. In the case of the Marabout stork it was not so much the size as the abundance of the prey which made them readily available, perhaps for a specially hungry bird, perhaps for one specialised to feed on distasteful insects. It was interesting to note that, of the two species of Mylabridae, one, *Zonabris aperta*, possessed a much-mimicked warning pattern of the type illustrated by Dr. G. A. K. Marshall in Trans. Ent. Soc., 1902, Pl. XIX, figs. 1–16; while the other, *Epicauta nyassensis*, with its blue-black patternless appearance, fell into a large association centred by the dark-winged Hymenoptera Aculeata, as shown by Dr. Marshall in Pl. XXI, figs. 23–25, of the same memoir.

A large moth accepted by the young of the Parrot-billed blackbird (Crotophaga ani L.).—The President exhibited the huge "Witch Moth," *Otosema odora* L. (Noctuinae), taken from the young of *Crotophaga ani* L. by Prof. R. Newstead, F.R.S., during his visit to Jamaica in 1908–9. The circumstances were explained in the following note :—

Locality.—Stony Hill, St. Andrew, 1909. "Another record of interest in reference to the food of this bird was made one day in the month of January, while watching the habits of a small family party bringing food to a fully-fledged young one, which had perched itself in a very convenient place for observation, quite close to where the writer was seated. At first one of the old birds was seen to advance with a huge mouthful of something, appearing most like a bundle of dark-coloured feathers, which it was seen to procure from the foot of a tree not far away. This object was offered to the young bird and accepted by it immediately; and while it was making a strenuous effort to swallow the dry-looking morsel, a couple of missiles thrown into the tree made it relinquish its hold of the object, which, when secured, proved to be the somewhat mangled remains of one of the huge black 'Witch Moths' . . . ., measuring originally nearly six inches in the wing expanse." *

* "Annals of Tropical Medicine and Parasitology," Vol. III, No. 4, November 1909, p. 453, Liverpool.

A specimen of the adult bird, kindly sent by Prof. Newstead, was also exhibited, enabling the Fellows to arrive at some conclusion as to the size of the young which had attempted to swallow the moth.

A Nymphaline butterfly, Prepona antimache Hübn., from Trinidad with symmetrical injuries to the fore-wings probably caused by the beak of a bird.—The President showed a specimen of this powerful butterfly captured near Port-of-Spain in 1918 or 1919, and kindly sent to him by Dr. C. L. Withycombe. The indirect evidence of attack was very convincing.

Episilia quadrangula Zett. (Noctuidae: Agrotinae) captured on the summit of Mount Hekla, Iceland.—The President exhibited the specimen of *E. quadrangula*, kindly determined by Mr. W. H. T. Tams, and communicated the following note by the captor Mr. A. C. Hardy. Mr. Tams had stated that the moth was not common.

"I am sending you the moth which I took last summer on the summit of Mount Hekla. I expect that it is a very common species, but may possibly be of interest taken from this locality and altitude: 5095 feet. I made the climb on August 1st (1924). Whilst walking between the two craters which form the very top, I saw the moth fluttering and being blown along the surface of the snow. This was between 1 and 2 p.m., during a snow shower; the wind was not very strong but gusty, and soon afterwards we were enveloped in cloud.

"The moth remained alive in my cigarette case until chloroformed on reaching Reykjavik two days later."

The scents emitted by the Neotropical Butterfly Heliconius erato hydarus Hew.—The President said that the late Dr. G. B. Longstaff had recorded the fact that the odour of both sexes of this species resembled "Witch-hazel" (*Hamamelis*). A male and female *hydarus* from the neighbourhood of Port-of-Spain, Trinidad (April 1907) had been placed by Dr. Longstaff in a series illustrating the scents of butterflies and given the note that the odour was Witch-hazel and "very persistent." Further details were recorded in his "Butterfly-hunting in Many Lands" (London, 1912). Thus, in March 1907 he took at Caracas, Venezuela, two male

hydarus "one only of which had a very strong odour, like acetylene, or, better, as Mr. G. H. Sworder of Tobago (who was familiar with the insect and its scent) suggested, hazeline, a preparation of the Witch-hazel (*Hamamelis virginica*). This insect is tenacious of life" (p. 314). Then in Trinidad (April 1907) "a female *hydarus* had such a strong Witch-hazel odour that it was quite perceptible through the net; two males, in which little or no scent could be detected during life, had a decided scent when their papers were opened at Oxford three weeks later" (p. 324). All the results obtained with this species were summed up on pp. 503, 504:—"Eleven males were examined: three gave a negative result and one was doubtful, but the remaining seven had a scent which varied from very slight to very strong, and was described as musty, like acetylene, or like hazeline. . . . Eight females were examined, only one with negative results; in the other seven the scent varied from slight to strong and was described as 'disagreeable,' 'like acetylene,' or 'like hazeline.' In one male and one female the scent was so strong as to be easily discerned when the butterfly was fluttering in the net.

"Five of the above butterflies were captured in Trinidad on April 14, 1907, and were examined for scent when their enclosing papers were opened at Oxford on May 6, or three weeks after death. One of them—*H. euryades*, ♀—had none; the others—*H. hydarus*, 3 ♂, 1 ♀—had a slight, but quite decided, scent. Yet, curiously enough, in the case of two of these male *hydarus*, I did not find it possible on the day of capture to be sure that they had any perceptible scent. Finally, when a drawer containing all my black and red *Heliconii* was opened on July 15, or three months after death, the odour, though faint and evanescent, was distinctly perceptible in spite of the presence of naphthalene."

In the autumn of last year I received from Dr. C. L. Withycombe in Trinidad a letter in which he stated that the scent of *H. erato hydarus* was that of carbylamine, well-known to chemists as most characteristic and offensive. In the following passage from a letter dated January 14, 1925, further details were given by Dr. Withycombe, and the presence of two different scents described:—

" I have one small observation which I can add upon *Heliconius hydarus*. I dissected out the scent-glands from the apex of the abdomen of a female in distilled water. They possessed a typical carbylamine odour. The watchglass containing them (in distilled water) was then covered, after adding a drop of hydrochloric acid, and was heated over a spirit-lamp for about two minutes. At the end of this period the carbylamine-like odour had entirely disappeared and instead there was a smell like sweet-briar, similar to that which I told you I had noticed with *Eueides aliphera* Godt.

" As a control experiment the glands from another female *H. hydarus* were heated in a covered watchglass with distilled water only. The carbylamine odour persisted, though perhaps somewhat weakened.

" I tried this experiment merely to see whether the substance in the glands would hydrolyse as does a typical carbylamine, and the result may, I think, be taken as positive. I do not suggest that the test proves much, but it supports, to a certain extent, the carbylamine theory.

" As regards the rose-like odour which persists after hydrolysis: this may be present all the time, although cloaked by the more noticeable carbylamine odour, or, on the other hand, the rose-like odour may be due to a substance nearly allied to the carbylamine and into which the carbylamine is hydrolysed. Either of these possible facts is interesting in view of the fact that the nearly-related *Eueides aliphera* has only the rose-like odour. Is it possible that the rose-like odorous substance is not in itself distasteful, or only slightly so, and that in consequence *aliphera* is dependent for its survival more upon its colour-scheme fitting in with that of a well-known distasteful group of butterflies than upon actual inedibility? *Heliconius hydarus* has a totally different colour-scheme and it also possesses the presumably distasteful carbylamine."

Dr. Longstaff detected in one male and one female of *aliphera* a strong " odour like that of a stable, or of asses "; in another female a " peculiar scent, (?) acetylene." The former female had a " slight flowery scent when dead " (*ibid.*, p. 503).

I asked my friend Prof. W. H. Perkin, F.R.S., about the test for carbylamine, and he informed me that for small quantities the scent was the only indication, but that this was very characteristic. In reply to a further letter from me Dr. Withycombe wrote on April 12 :—

" *Re* carbylamine and my experiment in hydrolysis of same (my letter 14th Jan.), I did not consider this much as a *test* for carbylamine. The odour of phenyl carbylamine is very characteristic, as Prof. Perkin says, and I have been quite familiar with it ever since I read Chemistry for a B.Sc. degree. The production of this odour is recognised as a delicate test for chloroform and also for many primary amines (aromatic) since the odour is powerful even in small quantities.

" To obtain confirmation of my opinion I asked Mr. P. E. Turner, Lecturer in Chemistry, to come with me on one trip, and I caught a specimen of *H. hydarus*. While still in the net we noticed the powerful odour, and before telling him what I thought, I asked him what it was. He was quite positive in his assertion that it was carbylamine and said that it was unmistakable. Since my bringing the matter to his notice he has on several occasions repeated the observation.

" Personally, I would not like to go so far as to say that it must be *phenyl* carbylamine, although Turner agrees that there is little or no difference in smell, but I feel certain that it must be *a* carbylamine. It may be the rose-like constituent odour which makes the slight difference.

" I am very doubtful whether the carbylamine smell could be preserved by sending glands in a sealed tube, and sterilisation by heat might alter the substance, but I will try experiments here. I am now sending you a tube of alcoholic extract of a few glands of *H. hydarus*. This is not at all strong-smelling and is of little use. Probably there will be no smell at all by the time it reaches England. I will prepare more when *Heliconius* appears again in numbers. They are difficult to get in the dry season."

Prof. Perkin, after reading this extract from Dr. Withycombe's letter, concluded that there was no doubt about the presence of carbylamine. The alcoholic extract arrived a few days later, and I at once took it to Prof. Perkin without

removing the cork. He and Dr. E. Hope, who also examined it, agreed that the smell was "amazingly like carbylamine," and that it confirmed the conclusion drawn from the letter. The tube was left corked up for about a fortnight and then offered to Dr. Eltringham, who at once recognised the scent of Witch-hazel, as did many friends, some of whom suggested "hazeline" and others "Pond's Extract." I then took it to Prof. Perkin, who said that the smell he had first recognised had disappeared and had been replaced by another he did not know. He is not familiar with the smell of Witch-hazel.

There can be no doubt that two scents are produced by the butterfly and the conditions under which they are respectively emitted, and the glands by which they are produced present extremely interesting subjects for investigation. It is possible that Dr. Longstaff's acetylene-like smell was the carbylamine and Dr. Withycombe's sweet-briar-like odour the *Hamamelis*. It is very probable, however, that a third, pleasant, epigamic scent is emitted by the male.

Gen. H. C. Tytler exhibited and made remarks on a number of Butterflies from the Indian Region.

Dr. H. Eltringham showed some lantern slides to demonstrate various histological observations on Lepidoptera.

Papers.

The following papers were read :—

1. "New Staphylinidae from India," by Dr. M. Cameron.

2. "A Revision of some old types of Formicidae," by Mr. W. C. Crawley.

3. "Teratological Specimens in the Hope Department of Zoology," by Dr. E. A. Cockayne.

4. "Notes on Nemoptera from Palestine, including a new species of Myrmeleonidae," by Mr. K. J. Morton.

5. "Grasshoppers (Orthoptera, Acrididae) from Northern Nigeria," by Mr. B. P. Uvarov.

Wednesday, October 7th, 1925.

Professor E. B. Poulton, F.R.S., President, in the Chair.

Election of Fellows.

The following were elected Fellows of the Society :—M. P. Latter, F.G.S., Weald Place, Sevenoaks, Kent, and F. R. D. Onslow, B.A., 10, Keswick Road, East Putney, S.W.

Portraits.

The Treasurer drew attention to four new portraits that had been hung in the meeting room, one being that of Mr. J. G. Children, the first President of the Society.

Discussions.

The President stated that at the next meeting on the 21st inst. opportunity would be given for any Fellow to bring forward matters for discussion relating to the business of the Society.

Exhibitions.

Beetles new to Britain.—Mr. Donisthorpe exhibited the following species of Coleoptera new to Britain; all taken by himself :—

Phloeopora teres Gr., Windsor Forest, 9.vii.25; *Priobium eichoffi* Seidl., Windsor Forest, 7.vii.24; *Cis coluber* Ab., Windsor Forest, 17.vii.25; *Lissodema kirkae* Donis., Windsor Forest, 25.vii, and 5.viii.25; *Smicronyx seriepilosus* Jour., Mickleham, 10.ix.09; *Dryophthorus corticalis* Pk., Windsor Forest, 9.vii, etc., 25, and made some remarks on their distribution, etc.

Interesting new races of Papilios from S.W. Abyssinia and Somaliland.—The President said that he had recently received, through the kindness of Mr. Arnold Hodson, a very fine collection of butterflies from various localities in S.W. Abyssinia. All were accompanied by full and excellent data. The complete working out of the collection would occupy a considerable time, but there were certain specimens

of such extreme interest that it was desirable to exhibit and, when new, describe them forthwith. In the course of the work it became necessary to describe also a new race of *P. dardanus* from Somaliland. With the exception of this race, discovered by Sir Horace Byatt, the whole of the material, exhibited to the meeting and described below, was captured by Mr. Arnold Hodson.

The types of the descriptions are in the Hope Department, Oxford University Museum, with paratypes of *Papilio dardanus byatti* and *P. d. hodsoni* in the British, Tring, and Witley Museums.

Papilio rex abyssinicus n. subsp.—A single male, the type of this hitherto unknown race, was captured by Mr. Hodson at the Ganji River, Nado's Prov., S.W. Abyssinia (5500 ft.): 7 Febr. 1925.

The fore-wings, as in *rex schultzei* Auriv., are broader than in *r. rex* Oberth., and *r. mimeticus* Rothsch., and they thus appear to be shorter. This, however, is not so, for the total expanse is 130·0 mm., whereas the average of several males from the Nairobi district is only about 115·0 mm. The edge of the fore-wing is nearly straight between the two points which would first come into contact with a line placed as nearly as possible parallel with the outer margin and brought up to it. In *r. rex*, on the contrary, the outer edge of the marginal spot in area 4 would be 2·0 mm. or more within the line. The difference, although when thus measured apparently small, renders each contour very distinct from the other, as distinct indeed as that of the female *r. rex* when compared with its male.

The entire upper surface of both wings is black, with cream-white markings except for a very slight trace of bright orange-brown fringing the lower (inner marginal) border of the sickle-shaped mark in area 1*b*. Thus the upper surface pattern resembles that of certain comparatively rare specimens of *r. rex* from the Nairobi district, but differs from *r. schultzei* in the trace of orange-brown.

The markings of the under surface are cream-white (of a deeper tint over the principal patch towards the base of the

hind-wing), except the basal half of area 8, including the whole precostal region, which is bright orange-brown bordered opposite the precostal vein by a pale but distinct yellow. The parts of the dark ground-colour exposed in the position of rest, viz. the hind-wing and apical section of the fore-wing, are olive-brown.

P. r. abyssinicus may be described as a race combining the pattern of the more primitive forms of *r. rex* with the shape of fore-wing in *r. schultzei*. The examination of a series and especially of the female would be of the highest interest.

A study of *r. abyssinicus* leads to the inference that the mimetic resemblance to a Danaine model was first evolved upon the under surface of the wings. In the resting position with the closed wings hanging down, the costal margins of fore- and hind-wing coincident, and the orange-brown in area 8 prominent as the foremost marking near the body, the resemblance to *Danaida formosa neumanni* Rothsch. would be remarkably close. The upper surface, on the other hand, differs from the model in the presence of only a minute trace of the orange-brown colour which covers so large a part of the Danaine fore-wing. The appearance of *rex abyssinicus* suggests that mimicry of the *Danaida* became complete on the under surface before it was initiated on the upper. The trace of orange-brown, which is only to be recognised on a close examination of the latter surface, cannot be looked upon as a stage in the development of mimicry by means of natural selection. It may probably, however, show the existence of a tendency for a colour developed on the under surface to appear on the upper, although in a different position and on a different wing,—a tendency which in a more pronounced form would raise the character to a level at which selection will begin to operate.

Several examples of *D. f. neumanni* were collected by Mr. Hodson, four males being taken by him at the same time and place as *rex abyssinicus*. A male, captured the following day, February 8, at Haeto River, Nado's Prov. (6950 ft.), and a female, February 19, at the locality of *r. abyssinicus*, were exhibited to the meeting.

The Abyssinian and Somaliland races of Papilio dardanus.—The comparison of Mr. Hodson's S.W. Abyssinian examples with others in the British, Oxford and Tring Museums led to the conclusion that, in this part of Africa, there are three races of *dardanus* distinguished in the males by the degree of development of the dark markings, the form of some markings and the shape of the fore-wing. The black markings are least developed in the hitherto undescribed race from the Golis mountains, 45 m. S.E. of Berbera, more developed in *d. antinorii* Oberth., and most developed in the S.W. Abyssinian race which is transitional towards the pattern of *d. polytrophus* Jord., and *d. dardanus* Brown. This last new race is of especial interest in that it serves to link the two other somewhat remote subspecies to well-known and widespread African forms of *dardanus*. I propose to name the first and third of the above geographical races after their discoverers, Sir Horace Byatt and Mr. Arnold Hodson.

Papilio dardanus byatti n. subsp.—In this well-marked race the black markings of the male are reduced to a minimum. The female is unknown, but almost certainly bears the same relation to the male as do the male-like females of the other two races.

Fore-wing.—The outer margin is indented with a deeper bay than in the other races, the apex more falcate, and the internervular yellow marginal lunules more pronounced. The black margin is less wide, being especially narrowed in areas 1*b*, 2, and 3. The internal edge of the black margin is more dyslegnic than in the males of any other race, and its contour is highly characteristic. The relation of this internal edge to the areas and veins of the fore-wing differs greatly in different parts of the Ethiopian Region. It is only possible here to refer briefly to the subject, but it may be said that in Madagascar, the West Coast and Fernando Po the black margin commonly invades the yellow ground-colour along the veins bounding areas 1*b* to 6 inclusive, producing deep serrations; that in most other localities, and to some extent in the above, such serrations are rare, being replaced by rounded bays, these by shallow bays, and these again by an approximately straight

line of demarcation between the black and yellow of each area. But in all these forms of contour there is a tendency, more or less marked, for the black pigment to pass inwards along the veins. In *d. byatti*, however, the yellow passes *outwards* along the veins while the black invades at the centre of the areas. The serration, thus produced in a manner the reverse of that described above, is strongly marked in areas 1*b*, 2, 3, and 7. It will be seen that there is a comparatively slight approach towards this contour in *antinorii* and *hodsoni*, while in other races it is often indicated by a slight invasion into the yellow at the centre of area 1*b*.

Hind-wing.—The great reduction of the black markings at once separates this race from all other forms of the species. The only important marks are those at the anal angle and in area 7. Between these the markings are absent or, when present, reduced to small spots. The tail of all the males is entirely without black pigment. Its margins are orange-ochreous, which colours nearly the whole terminal half of the structure. The tail is also more slender than that of *antinorii* and *hodsoni*.

Locality.—Near the summit of Wagar mountain (6000 ft.), Golis range, 45 m. S.E. of Berbera, Somaliland. 11♂, taken July 1–2, 1906, by Sir Horace Byatt.

Papilio dardanus hodsoni n. subsp.—It has already been pointed out that the males of this S.W. Abyssinian race differ from those of *d. antinorii* by an increase in the black markings, *antinorii* being intermediate between *byatti* and *hodsoni*.

Fore-wing.—The outer margin is straighter than in *antinorii* and the black margin heavier, especially in areas 1*b*, 2, and 3. In some specimens there is an approach to the serrated inner border described in *byatti*, in that the black projects into the yellow ground-colour at the centre of the areas as well as at the veins, thus producing a serration with double the number of teeth. The internervular tooth is most pronounced in area 1*b*, where an indication of a tooth may be sometimes found in the males of other races.

Hind-wing.—The marginal, submarginal and discal black markings, although excessively variable, are heavier than

in *antinorii*, which in this respect is often nearer to *byatti* than to *hodsoni*.

The pigmentation of the tails.—Dr. Jordan has kindly examined the males of the Abyssinian and Somaliland *dardanus* in the Tring Museum and finds the development of black in the tails to be as follows :—

Locality.	*Degree of blackening of the tails. Males to be understood when sex is not indicated.*
Eritrea.	3 with vein blackened, forming a thin dark line; 1 with vestige of spot above this line; 2 with black spot above line.
Shoa (the locality of the type of *antinorii*).	1 without black; 1 with black vein widened. (Oberthür's fig. of ♀ shows the tail without black).
Maraquo, Central Abyssinia.	2 without distinct line, one of them with a small spot above the vein. 1 ♀ with line vestigial, no spot; 1 ♀ with spot.
Gara Mulata, Harar distr., W. Somaliland.	1 with little, 1 with more black above the dark line.
Abd-el-Kadr, S. of Harar, W. Somaliland.	1 without black.
Gillet Mtns. and neighbourhood, E. Abyssinia.	7 without black or with thin line only; 13 with the black spot above the line small to very large. 5 ♀ with the spot.
S.W. Abyssinia.	1 without dark line, but with small spot; 1 with thin line and small spot; 18 with black well developed, one having almost the whole tail black. 5 ♀ with black line and spot.

The S.W. Abyssinian series is apparently *hodsoni* with the exception of two which may be *antinorii* or intermediate. The remainder are probably *antinorii* with some transitional forms, especially in the Gillet Mtns. district, where there appears to be a mixture of *antinorii* and *hodsoni*.

Mr. Hodson's series of twelve S.W. Abyssinian males correspond with those from the same area in the Tring Museum, one showing only the blackened vein as a thin line, the remaining eleven forming a series from the least dark with a small spot

above the thin line to the darkest in which nearly the whole tail is black. They are *hodsoni* with one or two exhibiting transitional characters. A single male with the dark line and a large spot above it from the Gillet Mtns. appears, in other respects also, to be *hodsoni* varying in the direction of *antinorii*. Another male from Gudji, Koritscha-Tomata, Dara R., E. of Lake Abaya, is *antinorii*, the tail being pigmentless and the black markings much reduced as compared with *hodsoni*.

The British Museum Collection contains nine males collected (May and June 1905) in various localities in S.W. Abyssinia, by Ph. C. Zaphiro. The black pigment in the tails varies from the thin line in one, the addition of a small black spot in two, a larger spot in one, to a heavy pigmentation in the remaining five. Of the four females one has lost the tails, two have a slight and one a strong development of black. All are *hodsoni* with more or less strong indications of transition to *antinorii* in some examples.

The females of *hodsoni*, so far as they are known, are of two forms—(1) male-like, as in *antinorii*; (2) the tailed *hippocoon*-like form *niavoides*, also as in *antinorii*. Of the former several examples exist in the Tring Museum and four in the British Museum. Of the latter one worn specimen with the remains of a long tail has been recently received from S.W. Abyssinian by the Tring Museum, while the second, captured by Mr. Hodson in the same area, has lost the part of the wings from which the tails arise. The close resemblance of the pattern to that of Lord Rothschild's example renders it almost certain that tails were formerly present. Both appear to resemble very closely the original *niavoides* Kheil (now in the Prague Museum), of which a figure (from Haase) may be seen in Dr. H. Eltringham's "African Mimetic Butterflies" (Oxford, 1910), pl. x, fig. 4.

Localities of d. hodsoni in the Hope Dept.—All S.W. Abyssinia and 1925. 10♂ 1♀—Nado's Prov. (2♂—Gamachisa, 6800 ft., February 6 : 8♂ including typé—Ganji R., 5500 ft., February 7 : 1♀—Baro R., 5600 ft., February 9). 2♂—Mocha distr., Ganji R., 5500 ft., February 19.

Much larger collections from many localities will be required in order to determine the boundaries of the areas inhabited

by the three races *hodsoni*, *antinorii* and *byatti*, and to ascertain how far the first-named is transitional into *d. polytrophus* or *d. dardanus* to the S. and W. of its locality. The importance of a long series will be realised when it is remembered that all the races of *dardanus* interbreed when they meet on the borders of their ranges, and that characters of one race become in this way carried far into the locality of another, and may appear in certain examples. This has long been recognised in the females, but it is also true of the males. Thus in the Hope Department a single male out of the great number from the Nairobi district is nearly indistinguishable from *byatti*, the most patternless of all the races of *dardanus*. If this had been the only specimen from the locality entirely erroneous conclusions might and probably would have been formed.

Papilio cynorta arnoldi n. subsp.—Three females and two males of this interesting Abyssinian race were exhibited to the meeting.

The male.—Only differs from that of *c. cynorta* F., and *c. peculiaris* Neave, in the more emphasised white marginal spots of the hind-wing. The apical marginal spot of the fore-wing, often minute or wanting in *c. cynorta*, is distinct in both examples. Two white streaks, one on each side of the internervular ray in area 5 of the hind-wing underside, appear on the upper surface of one male. A partial transference of the corresponding marking to the upperside of *P. echerioides oscari* is seen in three males out of eight.

The female.—Differs from *c. cynorta* and *c. peculiaris* in many respects. The appearance of the latter is indeed entirely different, representing a development from *c. cynorta* in a direction opposite to that which has produced *c. arnoldi*. This conclusion, together with most of the upper-surface characters described below, can be verified by reference to figs. 4, 6, and 8 of Plate D.

Fore-wing.—The large white marking extending inwards from the inner margin occupies a much greater part of areas 1*a* and 1*b* than in *c. cynorta*, but does not extend far into area 2, as it commonly does in the latter race. In two examples thinly scattered scales along vein 2 are the only

traces of the marking in area 2. In the third and smallest female the extension is carried much further, but is still no more than a powdering of white scales. The apical white marginal spot in area 8 is far larger than in *c. cynorta*, and is followed in one example by a small marginal spot in area 7. In two females submarginal white spots are present in areas 1*b*, 2, and 3, increasing in size until, in the last area, the largest spot forms a discontinuous prolongation of the oblique white bar. In the third and smallest female the spot is absent from area 1*b*. Small submarginal spots in areas 4 and 5 are distinct in one specimen; reduced in area 5, obsolescent or wanting in area 4, in the other two. Of these submarginal spots only the three in areas 1*b*, 2, and 3 are present on the under surface.

Hind-wing.—Differs conspicuously from that of *c. cynorta* in the much greater peripheral extension of the white patch and in the size of the marginal spots. In *c. cynorta* the distal edge of the broad white bar near the base of the wing passes very gradually into a pale sepia, this into a darker tint, and this again into the dark ground-colour which invades the paler zone, forming the strongly marked internervular rays. This zone, which is sometimes tinged with yellow in *c. cynorta* or with orange in some Uganda specimens transitional to *c. peculiaris*, becomes white in *c. arnoldi*, although the dark rays remain, together with a sprinkling of dusky scales. In one of the larger females the peripheral margin of the white patch passes gradually into a broad zone of warm sepia, indicating the persistence of one of the steps by which the change took place. In the other two examples the margin of the white area is, although dyslegnic, clearly defined and equidistant from the margin of the wing. The six internervular, marginal, white spots, increasing in size from the anal angle to the apex of the wing, are smallest in the small female. Their effect is to increase strongly the apparent depth between the crenulations.

Under surface.—The characteristic brown triangle at the base of the hind-wing of *c. cynorta* is darker and smaller in the male *arnoldi*, crossing the cell at the origin of vein 7 (within this point in one specimen) and well within the origin of vein 2.

In the female it is much smaller, crossing at midway between 7 and the wing base, and at the junction of the basal and middle thirds of the distance between 2 and the base. This reduction involves the disappearance of the outer of the two black spots in area 7 and the proximity of the inner spot to the distal edge of the triangle.

Localities.—All S.W. Abyssinia and 1925.

♀ type (Pl. D, fig. 8)—Grine, 4000 ft.: March 2.

1♂—Baro R. Prov., Kella, 3650 ft.: February 2.

1♀ (small)—Bako R. distr., Yeki, 4400 ft.: February 23.

1♂—Bako R. distr., Koricha, 3700 ft.: February 25.

1♀ (warm sepia zone in H.W.)—Gemira distr., Tirka, 4200 ft.: February 28. A male and female *Amauris niavius aethiops* R. & J., taken on this last date, were exhibited to the meeting, the female being represented on Pl. D, fig. 7.

The mimetic relationships of the female *c. arnoldi*, represented on Pl. D, are of great interest. The female of the W. African race *c. cynorta* (fig. 4) is represented with its model the female of *Planema epaea epaea* Cram. (fig. 3). Passing eastward into Uganda *e. epaea* is represented by the race *e. paragea* Gr.-Sm. (fig. 5), with both sexes alike. Transitional forms occur in the Semliki valley. The female *c. cynorta* undergoes corresponding changes, becoming *c. peculiaris* Neave (fig. 6), the male remaining as in *c. cynorta* (fig. 2). Intermediates between the females of *peculiaris* and *cynorta* are common in W. Uganda, while Dr. G. D. H. Carpenter has shown that *c. cynorta* persists unchanged in the forest areas in Tanganyika Territory a little south of the Uganda border. Finally in Abyssinia, where the female *Planema* of the race *epaea homochroa* Rothsch., possesses the bright orange-brown colour of the male *e. epaea* (fig. 1), the female of *cynorta arnoldi* (fig. 8) has become the mimic of both male and female of the Danaine *Amauris niavius aethiops* (fig. 7).

The mimicry of the Danaine model and loss of the likeness to the Acraeine is shown in the obsolescent brown triangle at the base of the hind-wing underside, and especially in the increase in size and the form of the chief white marking of the upperside, continuous over both fore- and hind-wing.

The narrow oblique bar of the fore-wing is very similar to that of the Danaine model, while the white submarginal spots in areas 1*b*, 2, and 3 would upon the wing probably produce an effect similar to that of the smaller more numerous spots of the Danaine, and the large apical spot of the mimic to the two small subapical spots of the model.

Other characters appear to indicate an approach to co-mimics of the same model—the *niavoides* female of *Papilio dardanus hodsoni* and its *hippocoon* female if this also occurs in S.W. Abyssinia; also to the *anthedon* Dbl. form (if present) of *Hypolimnas dubia* P. de B. A specimen of the form *dubia* captured by Mr. Hodson exists in the collection. These characters are the dyslegnic margin of the chief white marking and its penetration by dusky internervular rays in the hind-wing.* Also the strongly marked marginal spots of the hind-wing giving the appearance of a pronounced crenulation, or when more distinctly seen producing some of the effect of marginal and submarginal markings of the co-mimics.

Papilio echerioides oscari Rothsch.—A fine series of males and two females of this race were received from Mr. Hodson. Six out of eight males, taken (January and February, 1925) at various localities in S.W. Abyssinia, were exhibited, together with the two females of which one was captured at the same place and time as *P. rex abyssinicus* and the second on 17 February, 1925, at Alga (5900 ft.). A male and female of the model, *Amauris echeria steckeri* Kheil, taken with the first-mentioned female *oscari*, were also exhibited. The resemblance between model and mimic was especially striking in the deep ochreous tint of the markings and the reduction in size of the basal patch on the hind-wing as compared with other races of *echerioides* Trim. mimicking other forms of *Amauris* with the corresponding marking of a larger size and paler shade than in *steckeri*.

* The chief marking of the hind-wing in the single *niavoides* female captured by Mr. Hodson (p. xlviii) is free from invasion by these rays, but this is a character which varies greatly in the corresponding forms (*hippocoon* F., and *hippocoonoides* Haase) of *P. dardanus* in other areas and may probably be found to vary in *niavoides*.

Explanation of Plate D.

The races of *Papilio cynorta* in West Africa, Uganda, and Abyssinia, with the Acraeine or Danaine model of the female in each locality.

Fig. 1. ♂ *Planema epaea epaea* Cram.—Forest, a mile from Oni, 70 miles E. of Lagos: 24 Sept. 1910. W. A. Lamborn.

2. ♂ *Papilio cynorta cynorta* F.—Data as in fig. 1, except the date—6 Oct. 1910.

3. ♀ *Pl. e. epaea.*—Data as in fig. 1, except the date—29 Sept. 1910. The Acraeine model of ♀ *Papilio* represented in fig. 4.

4. ♀ *Pap. c. cynorta.*—Data as in fig. 1, except the date—18 Sept. 1910. Mimic of Acraeine model represented in fig. 3.

5. ♀ *Pl. e. paragea* Gr. Sm.—Native coll., forest E. slope Kitabi Hill, abt. 2 m. N.E. of Entebbe, Uganda (abt. 4000 ft.): 1 June 1912. C. A. Wiggins. The pattern of the male is similar. The Acraeine model of the ♀ *Papilio* represented in fig. 6.

6. ♀ *Pap. c. peculiaris* Neave.—Data as in fig. 5. The male resembles fig. 2. The female is a mimic of the Acraeine model represented in fig. 5. It will be seen that model and mimic were taken in the same locality on the same day.

7. ♀ *Amauris niavius aethiops* Rothsch. & Jord.—Tirka, Gemira district, S.W. Abyssinia (4200 ft.): 28 Febr. 1925. Arnold Hodson. The pattern of the male is similar. The Danaine model of the ♀ *Papilio* represented in fig. 8.

8. ♀ *Pap. c. arnoldi* n. subsp.—Grine, S.W. Abyssinia (4000 ft.): 2 March, 1925. Arnold Hodson. The male differs but slightly from fig. 2. The female is a mimic of the Danaine model represented in fig. 7 and also probably exhibits an approach to the co-mimic *Pap. dardanus hodsoni*, n. subsp., ♀ f. *niavoides* Kheil, and possibly to *Hypolimnas dubia* P. de B., f. *anthedon* Dbl.

Races of *Planema epaea*.
Figs. 1, 3, 5.

Races of *Papilio cynorta*.

A. Robinson, photo. *Vaus & Cramplon, Ltd*

(All figures are five-ninths natural size).

Races of *Papilio cynorta* and the models of their females in each area. The male of each race is similar to fig 2.

Various observations on insects in Uganda by Dr. G. D. H. Carpenter.—The President communicated the following notes and exhibited the specimens sent by Dr. Carpenter in illustration of his interesting observations. In the determination of the species kind help had been rendered by Major E. E. Austen, D.S.O., Mr. K. G. Blair, Mr. G. E. Bryant, Mr. W. E. China, Capt. N. D. Riley and Mr. W. H. T. Tams.

The following observations were made on Bukassa Isle, Sese Archipelago, N.W. Victoria Nyanza, April 4–5, 1925.

A Pentatomid larva attacking an Acraeine larva.—I have previously recorded the fact of a Pentatomid bug attacking Acraeine larvae which must be looked upon as "Protected Insects," so far as vertebrates are concerned. The young bug sent herewith was taken in the act of sucking a larva of a common small *Acraea*, but dropped it before I could get it.

[The Pentatomid is the larva of a species of Asopinae, probably *Afrius purpureus* Westw.]

Malformed male Cassidid taken in copulâ.—A pair of brownish Cassidids were taken *in copulâ*, of which the male is by no means perfect, having the right wing and elytron mal-developed. Being a common species one would have expected other males to have been more successful in the competition for mating, if such competition exists.

[The species is *Aspidomorpha* (*Conchyloctenia*) *fibrata* Spaeth.]

A pair of Lymexylonidae (*Atractocerus*) *in copulâ.* On a leaf in the jungle something very peculiar-looking attracted my attention. It was disposed vertically on the leaf and looked like a thin, wet, black, rolled-up leaf, or some other dead, wet, decayed, organic substance. On close inspection I saw thin legs closely apposed to the long slender mass, and decided it was an insect. It proved to be two of these extraordinary beetles *in copulâ*, the much smaller male hanging head downwards behind the female. It is difficult to describe the feeling of "wetness" that the appearance of the beetles gave me: perhaps it was caused by a shimmer of light from the folded, exposed wings. I have very seldom met with these curious beetles, and well remember one evening in 1912 when the first

one I had ever seen flew to light in my camp on Bugalla Island and puzzled me much.

[The species is *Atractocerus brevicornis* L.]

The following observation was made on another island of the Sese Archipelago.

A mature larva of Microdon (Diptera) in an ants' nest.—On a small islet, Ngabu, near Fumve, on March 31, 1925, I was turning over stones and laid bare a nest of a small species of ant, probably a *Pheidole*. On the under surface of the stone was a peculiar-looking creature. Almost hemispherical, smooth and firm, not slimy to touch, and showing no sign of life, it completely puzzled Symes and me. Under the lens one could see a small papilla at one end. It was impossible not to think that it was in some way associated with the *Pheidole* and if not attended to by them probably ate their larvae. The tough firm skin would at least be some protection, as the ant was small even for a *Pheidole*. I unfortunately forgot to secure some specimens.

[Major Austen considered that the specimen was a mature larva, attached to the stone preparatory to the formation of a puparium. It much resembled in size and other external characters the *Microdon* larvae found associated with ants in this country. These larvae were discovered by Mr. H. Donisthorpe to be scavengers, feeding on the excreta and pellets from the infrabuccal chamber of the ants, which never molested them.]

Miscellaneous notes on some insects from Gulu district, Northern Province of Uganda, April–May, 1925.

The Hesperid Rhopalocampta forestan Cram., exuding droplets and imbibing them again.—Gulu station, April 29, at about an hour after sunrise, this specimen flew into my tent, and after apparently investigating my soft brown leather mosquito boots settled on one, bent the tip of the abdomen forward, as when ovipositing, and ejected a droplet of fluid. The proboscis was then directed backwards beneath the body and the droplet was imbibed, without any change in the position. This happened several times, and even after the Skipper had been alarmed and flew out of the tent, it found its way back

so that I was able to confirm the observation and capture the specimen.

[This is a very interesting addition to the observations recorded in Proc. Ent. Soc. Lond., 1923, lxxxii, and the references which may there be found.]

A Liptenine Lycaenid with remarkable underside pattern.—At Lamogi camp, May 5, this specimen, settled on a leaf, at once attracted my attention by the very unusual type of coloration on the under surface: the area is roughly divided into two shades, without any of the usual spots or stripes. It recalls the under surface of many small Geometridae.

[The specimen is a male of *Aslauga purpurascens* Holl., differing, in the broad, uniformly dark, marginal border of the underside, from any example in the British Museum or Hope Department. Most of the specimens in these collections exhibit only a dark line, which corresponds with the inner edge of the border of this remarkable variety. A very few are transitional in the presence of shading outside this line.]

A predaceous bug (Mononyx) and its prey.—At Adzugopi Camp, E. Madi, May 12, seeing a disturbance among loose sand on the road, I investigated and found a small Coprid struggling in the embrace of the Cryptoceratous bug. This species, or one closely resembling it, has been found to capture the Lycaenidae which settle on wet sand to drink.

[The Hemipterous insect is *Mononyx grandicollis* Germ. (Mononychidae) and its victim *Onthophagus inermiceps* d'Orb., ♀, except for the unique type in the British Museum, the only known example of the species. Dr. Carpenter's observation of the same species of bug devouring a Lycaenid butterfly is recorded in Proc. Ent. Soc. Lond., 1915, pp. lxiii, lxiv. A later observation will, it is hoped, be communicated to the Society in the near future. It is improbable that the captured Lycaenids were attracted to the bug by its resemblance to a bird-dropping; for it is known that allied Hemiptera creep towards and suddenly spring upon their prey.]

Resemblance of certain African insects to charred wood and partially burnt grass.

[A specimen of the Pentatomid bug *Macrina juvenca* Burm. from Amua camp in the Gulu district (May 19), was also

exhibited. Dr. Carpenter had pointed out its resemblance to a partially burnt, sharp-cornered chip of wood of which two examples sent by him were exhibited to the meeting. The full note with a record of other resemblances to the effects of grass-fires will appear in the Proceedings of the Third Internat. Entom. Congr., Zurich, 1925.]

A colour association between a Longicorn and Phytophagous beetle.—This association was taken on Mt. Otze, near the Sudan border in West Madi, about 3000 feet above the Nile, on May 20. I first found the canary-yellow and black Lamiid on a twig in the evening, and next evening found the similarly marked Phytophagous species which accompanies it sitting on top of a grass-stem as conspicuous as was the Lamiid.

[The Phytophagous beetle is *Diapromorpha concinna* Lac. (Clytrinae); the Lamiid Longicorn *Tragocephala chloris* Chevr. The pattern is of the Cantharid type figured by Dr. G. A. K. Marshall in Trans. Ent. Soc. Lond., 1902, Pl. XIX, figs. 1–16.]

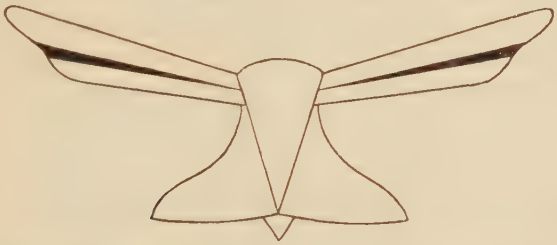
The following two observations were made at Kampala and Entebbe, respectively.

Noise made by a Hesperid butterfly in flight.—Clicking or rattling noises are known to be produced by several species of butterflies, and have been described from various parts of the world. I am not aware, however, that the Hesperidae are known to do this. Near Kampala, Uganda, on the evening of June 11, 1925, in the last few minutes of twilight I noticed a large dark brown or black insect darting rapidly about with the typical " Skipper " flight. As it flew it produced a high-pitched rhythmical noise which can only be compared with the loud ticking of a watch, each individual tick being slightly slurred or prolonged. The butterfly circled rapidly about among the banana plants and for a while was joined by another, but I could not decide whether one or both produced the noise. The species cannot be determined, for I could not see the insect clearly in the dark as it darted about, nor could I see it settle. At times there was a suggestion of a white patch on the wings; I could not see that it had white antennae, like some of the species of Skippers. It was much

too dark in colour to be *Gamia bucholzi*, whose crepuscular habits are well known.

[In a later letter, written September 25, Dr. Carpenter expressed his belief that the Hesperid was not a *Rhopalocampta*, but thought that it might be *Ploetzia cerymica* Hew. well known to be crepuscular (Proc. Ent. Soc., 1924, pp. xxxii, xxxiii, and references). It is probable that the group of pale yellow spots near the centre of the fore-wing and repeated on the underside would, during flight in the dusk, produce the " suggestion of a white patch " noticed by Dr. Carpenter.]

Specialised resting attitude of a Geometrid moth.—The accompanying specimen was seen at Entebbe, June 13, 1925,



Resting attitude of the moth *Coenina aurivena*. From a sketch by Dr. Carpenter. The shaded area along the fore-wing represents the deep fold which causes the middle part of the expanse to lie beneath the costal part.

on a lamp in the very unusual attitude now described, from which it did not budge after it was made to crawl on to a piece of paper and covered with a glass, where it remained motionless till put into a cyanide bottle.

The fore-wings were entirely dissociated from the hind-wings, which were directed so that the two anal angles just met over the end of the abdomen, whose extreme tip was visible beyond them. The narrow white border of the hind-wings was conspicuous.

The fore-wings projected slightly in front of a line drawn transversely across the front of the head, and had an extremely narrow appearance, because the greater part of the central area was folded so that it lay directly beneath the anterior part. The wing thus appeared to be very narrow, for the costal border and hind margin were the only parts visible.

The general effect was that of a huge Plume moth. The anterior part of the body was raised high up on the legs, and the tip of the abdomen touched the ground so that the general body-line made an acute angle with it.

The accompanying pencil-sketch made at the time will give an idea of the general appearance. One would expect the neuration of the wing to be very unusual to allow of this doubling of the central portion.

[The species is *Coenina aurivena* Butl. : Boarmiinae (Urapteryginae). The figure has been copied from Dr. Carpenter's drawing.]

Interesting Tettigoniidae (Orthoptera) from Costa Rica.—The President exhibited two species sent to him by Mr. C. H. Lankester. One of these, a beautifully procryptic form, taken June 6, 1924, at Las Concavas, Cartago (4500 ft.), was *Centrofera bimaculata* Br.-W., ♀. Its appearance in life was thus described by Mr. Lankester :—" Body except dorsally, wing spots, ovipositor and costal margins of elytra dead-leaf brown, rest of elytra dark apple-green. Body dorsally pale apple-green, tarsi hyaline. Two beautiful impressed, cordate, deep matt-green marks surrounded by ochreous on dorsum of thoracic shield. The eyes like polished mahogany." The appearance was that of a green leaf with the brown marks caused by the attacks of fungi or leaf-mining larvae or of both combined.

The second specimen was *Markia hystrix* Westw., ♂, taken at light on the same date and in the same locality as the preceding insect, but at 4700 ft. Mr. Lankester noted that it " stridulates very loudly." It would be of much interest to know the natural surroundings of this wonderful, pale green, black-marked insect with its thorny limbs, its two stout median spines on the thorax and one on the head. The network-like appearance of the green elytra, their squarely cut ends with the pattern doubtless continued in the position of rest by the tips of the underwings, and the black elytral patches made up of scattered small spots are other features which, it is hoped, may be studied in the living insect.

The specimens were kindly determined by Mr. B. Uvarov.

Development of scent-scales in Pieris rapae.—Dr. F. A. Dixey exhibited some lantern slides of preparations of the wing of *P. rapae* at various stages before emergence from the pupa, and remarked on them as follows :—

"It is well known that the scales on the wings of Lepidopterous insects are developed as outgrowths of cells underlying the chitinous membrane of the wing; but so far as I am aware no attempt has hitherto been made to distinguish the growth of the specialised scales concerned in the distribution of scent, from that of scales of the ordinary character. With the help of some preparations kindly made for me by my friend Dr. Eltringham, I have been able to trace some at least of the steps in the development of scales of both kinds, and to determine the points of difference that characterise the growth of the scent-scales. The form chosen for investigation was the summer brood of the common Garden White (*Pieris* [*Ganoris*] *rapae* Linn.). In this species, as is usual in its group, the scent-scales occur on the upper surfaces of both fore- and hind-wing in the male, but are not found on the lower surface of either, or in the female.

"A section taken longitudinally through the pupal wing on the second or third day of pupation shows a double layer of cells with a cleft between. This cleft marks the original cavity between the two membranes of the wing, upper and lower. In the adult wing the cavity has disappeared, and the two membranes are in contact. There is a certain amount of fibrous material bridging the cleft, and also taking a more or less longitudinal course between the layers. A row of large nucleated cells underlies each of the wing-membranes, both upper and lower; but there is little or no indication of any chitinous sheet or envelope bounding the row of cells on their free external surface. The developing scales are clearly visible as club-shaped processes, apparently protoplasmic, still in contact with the cells from which they take their origin. The cells tend to run in pairs, the pairs being separated from each other by supporting fibres. The latter do not appear to be nucleated. There is no sign of any folding or pleating of the wing, nor do I find any character pointing

to a differentiation between the ordinary scales and those specialised for the distribution of perfume.

"In sections of the pupal wing of the fourth or fifth day of pupation, there is a distinct suggestion of a limiting membrane, probably chitinous, continued along the free border of the line of cells belonging to the upper surface of the wing. These cells of the upper surface are longer than those of the lower surface, resembling in fact a columnar epithelium. The scale-processes have flattened out, becoming almost linear in longitudinal section. The cells, as in the former stage, appear to be grouped in pairs, each pair on the upper surface usually consisting of a broad, roughly rectangular cell, with an adjacent cell, also columnar, and of the same length as its companion, but comparatively thin. Cup-shaped projections, usually one to each alternate cell, are present on the free border of some of the cells of the upper surface; each projection emitting one of the embryonic scales. From the fact that these cup-shaped projections are seen only on the upper surface, and usually on alternate scales, it seems allowable to conjecture that the cells to which they belong are those from which are developed the specialised scent-scales.

"The next stage, that of the sixth or seventh day of pupation, shows the beginning of the process of folding or pleating, which is so marked a feature of the wing just before emergence. This pleating is brought about, not by the crinkling of a previously flat membrane, but by the establishment of clefts, which appear alternately on the outer and inner surface of the layer of cells, causing the series to assume a zigzag outline. The specialised cells, the 'thin' cells of the preceding stage, are now seen each to enclose a fusiform body which I think may be almost certainly identified with the accessory disc of the adult scent-scale. This body is included within a cup-shaped depression or socket on the free border of its own cell, this socket being now below the general level instead of, as in the former stage, projecting above it. The ordinary scale-producing cells are seen each to be provided with a scale-process lodged in a socket of different character from that of the receptacles just mentioned. The specialised

cells are now distinctly shorter than their neighbours, and their nuclei are generally ranged nearer the surface.

"At the eighth or ninth day, the pleating already visible in the previous stage has become very distinct. It is completed on the upper surface by the appearance of clefts, communicating with the interior of the wing, and alternating with the already existing upper clefts which result from the fact that the specialised cells have come to occupy depressions of the general surface. The sockets of the specialised cells now possess well-defined lips, sharply marked off from the remainder of the cell. Each socket contains, as before, the accessory disc of a scent-scale. In some instances the disc may still be in connection with the cell from which it was derived; but Dr. Eltringham's preparations do not enable me to assert this with any confidence. A feature not observed in earlier stages is the presence of small hypoderm cells, with correspondingly small nuclei, underlying the layer of chitin which now bounds both surfaces of the wing-membrane. These cells are not distinctly marked off either from each other, or from the superjacent chitin.

"In the last, or nearly last, stage before emergence, the pleating of the membrane and the alternation of ordinary with specialised scales are even more evident than before. As far as appearances go, it must be concluded that continuity has now been definitely lost between the scent-scale and its parent-cell.

"When the expanded wing is examined in the adult, after the removal of the scales, it is seen that the ordinary and specialised scale-sockets occur in alternate rows. This is a consequence of the smoothing-out of the folds or pleats; the ordinary scales, which were set on the ridges, being now brought into the same plane with the scent-scales, which occupied the furrows in the pleated condition."

A Gynandromorph of Papilio androgeus.—Mr. Arthur Dicksee exhibited a pair of the very rare *Morpho uraneis* from Iquitos, and also a gynandromorph of *Papilio androgeus*, together with a normal male and female. He said that the peculiarity of this specimen seemed to be the number of places on the four wings where the male marks appeared

on what was mostly a female ground. This occurred in about a dozen places. The abdomen too, instead of being as in the male, yellow, with a black dorsal band, or in the female, black, with a yellow side band, was black, spotted all over with yellow.

Mr. H. M. Edelsten exhibited a banded variety of *Chiasmia clathrata* taken in the Cambridgeshire fens on 10th June, 1925.

Mr. W. J. Kaye gave some account of his paper on the butterflies of Jamaica and exhibited some specimens of the characteristic species that occur on that island.

Wednesday, October 21st, 1925.

Professor E. B. Poulton, F.R.S., President, in the Chair.

Election of Fellows.

The following were elected Fellows of the Society:—Dr. A. J. Hesse, South African Museum, Cape Town; Rev. J. R. J. Llewellyn Jones, M.A., Newcote, West Avenue, Exeter; and Mr. A. Robinson, B.A., Bretavely, Seal, Nr. Sevenoaks, Kent.

Obituary.

The President announced the death of Professor H. Maxwell Lefroy, and a vote of condolence with his relations was passed.

Discussions.

Discussion took place on the conduct of the Society's meetings, the points considered relating to (1) the desirability of notifying Fellows of the Agenda at the meetings, through the Press, or otherwise; (2) the desirability of improving the circulation of the exhibits at the Meetings.

Exhibitions.

The Prothoracic Gland in Pierines.—Dr. E. A. Cockayne exhibited preserved larvae of *Pieris brassicae*, *P. rapae*, *P. napi*, *Colias croceus*, *Euchloë cardamines* and *Gonepteryx rhamni*, showing that in all these Pierine butterflies

there are two prothoracic glands, each with a separate papilla. In *Pieris* the everted glands are widely separated; in *Euchloë* and *Gonepteryx* they are close together. In all other Lepidopterous larvae examined there is a single papilla for both glands situated in the middle of the ventral aspect of the prothorax.

Butterflies from Corfu.—Mr. P. P. Graves exhibited Rhopalocera from Corfu taken from July 4 to July 9, 1925. These included *Polyommatus* (*Agriades*) *thersites* Chap., a new local record: a very large *hispulla*-like race of *Epinephele jurtina* L.: *Satyrus syriaca*, Stdgr.; a large race of *Hipparchia semele* L., on the whole resembling *cadmus* Fruhst. as figured by Stauder, Zeits. f. Wiss. Insektenbiologie, 1922, Pl. I; and the local subspecies of *Agapetes larissa* HG., which was figured by Freyer and has been named s.sp. *freyeri* by Fruhstorfer. Dr. Rebel considers that this name may fairly be applied to the *larissa* race from S. Albania and Corfu. Another large race exhibited was *Dryas paphia* L. s.sp. *kerkirana* Buresch, which is perhaps the largest race of *paphia* in the Western Palaearctic region. In this race, the ground-colour of the ♀ is distinctly more reddish-yellow than in the usual European and West Asiatic specimens, the dark markings are pronounced and the underside, instead of showing a decrease or absence of silver marking as do the Greek and Corsican forms of the species, is very strongly marked with silver.

A Cassidid beetle pest of a timber-tree in Kenya Colony.—The President exhibited, on behalf of Dr. V. G. L. van Someren, a leaf of the "Muhugu" from which most of the chlorophyll-containing tissue had been stripped by the larvae of *Cassida jeanneli* Spaeth.; also the beetles and their larvae in different stages, kindly determined by Mr. G. E. Bryant, together with their Hemipterous enemies the Pentatomid *Macrorhaphis infuscata* Walk. (Asopinae) and the Reduviid *Phonoctonus formosus* Dist., kindly determined by Mr. W. E. China.

Dr. van Someren had written, May 9, 1925, from Nairobi :—

" The Cassidid does an immense amount of harm to a valuable timber-tree called ' Muhugu,' *Brachylaena hutchinsii*, by destroying the young growing shoots and thus maiming the growth. The Reduviids feed on larvae, pupae and adult beetle."

A female larva of Drilus flavescens Rossi, in the last feeding stage, found in a house near Winchester.—The President exhibited, on behalf of Commander J. J. Walker, who was unable to be present, a female larva of *Drilus flavescens*, found by Mr. F. C. Woodforde on the window-sill of a house near Winchester, June 1925. Commander Walker had also sent the following note :—

" The male of this beetle is well known, and is often found quite commonly in the south of England, by sweeping in chalky places where snails abound, but the apterous female in all its stages lives concealed in the shells of the snails (chiefly *Helix nemoralis*) on which it feeds, and is very rarely seen at large in these islands. In the Mediterranean region it is much more in evidence, and at Gibraltar and Malta I have several times met with the full-grown female larva and the female imago in the open; the imago being invariably accompanied by a crowd of males. Mr. L. R. Crawshay has found the ♀ *Drilus* in small numbers on the South Downs, and has given an exhaustive account of the life-history of the beetle in Trans. Ent. Soc. Lond., 1903, pp. 39–51, Plates I, II."

Troides brookiana albescens Rothsch., in crowds at mud near Kuala Lumpur, F.M.S.—The President said that he felt sure the Fellows would be interested to hear of Mr. Hubert W. Simmonds' experience with this magnificent butterfly. The following passage was quoted from his letter, written July 2, 1925, at Kuala Lumpur :—

" I have only been to the jungle five times. I have seen very few striking species except *Troides brookiana albescens* Rothsch., and a yellow and black Ornithopteron [probably *T. helena cerberus* Feld.] and one or two Nymphalinae. There was one day which was a *brookiana* day. We went about 3 miles into the jungle (we had seen tiger pug-marks on the

side of the creek, but the Malay boy told me that the tigers there were 'good tigers'), and taken several *brookiana* as we went along, and then on a piece of wet mud were 4 clusters of males. The largest cluster was about 18 inches in diameter and must have had from 40–60 specimens on it, and altogether there must have been a hundred in that tiny patch. I disturbed them and then passed my net through the crowd, capturing seven in the stroke. It was a sight to remember. I have, however, yet to see a female. Strange that a butterfly so striking and so abundant is yet to be discovered in the larval stage."

A NOTE ON THE LARVA OF AMPHIDASYS BETULARIA L.—The PRESIDENT said that his friend, the Rev. W. Shirley, had found, in his garden at Oxford, a larva of this Geometrid moth feeding on "Aster vimineus Maidenhood" of Barr's catalogue. This Michaelmas Daisy had very small leaves and green stems, and the larva itself was green, as was to be expected, inasmuch as it was well known to possess the power of producing colours to harmonise with the parts of its natural food-plants on which it retires to rest (Trans. Ent. Soc. Lond., 1892, pp. 326–360, Pl. XIV, figs. 10–17). He had not previously met with this larva feeding on a herbaceous plant, although the occurrence of green larvae on broom, sallow, and *Ribes americana* was recorded in the above-quoted paper (p. 360). Mr. Shirley's larva was willing to eat the young tender leaves of apple, but refused the old ones. It was placed in a commodious glass jar with a quantity of fine loose earth. At 8.0 a.m. on September 16 it had ceased to feed at some unknown earlier hour, and was observed by Mrs. Shirley to be wandering round and round the jar on the surface of the earth. At 6.0 p.m. it was still wandering, but when next looked for, a little before 7.0, it had disappeared under the earth. On the next morning the larva was seen through the glass side, in the position where it pupated, at a depth of three inches. It thus became clear that even the most suitable conditions do not provide a stimulus to bury until after the lapse of a considerable period during which the larva actively wanders. *Then* the stimulus operates suddenly and

quickly. It could hardly be doubted that we see here the manifestation of an adaptive instinct, preventing the accumulation of pupae close to the trunk of the tree on which the larvae had fed. It must often have occurred to pupa-diggers that their finds are an extremely small proportion of the larvae which had been supported by the tree round which they had been digging. This was doubtless the result of an imperative instinct to wander and the delay of the instinct to bury, while the successes of the pupa-digger must be due, in large part at least, to the failure of these adjusted instincts in a small proportion of the larvae.

The influence of certain Micro-lepidopterous larvae in preserving the tissue of autumnal leaves so that it remains green and is free from attack by other larvae. —The President exhibited the three oak-leaves referred to in the accompanying note by Mr. E. G. R. Waters, who was unable to be present. Mr. J. H. Durrant had informed him that he had been long familiar with the preservation of the green area in the changing leaves, but that the further preservation from the attacks of other larvae was entirely new to him. He had also kindly supplied the reference to J. W. Tutt, Br. Lep. I, 176–7 (1899), where a good historical account of the colour preservation was given, going back to the earliest publication in 1843 by von Heyden. Of special interest were J. H. Wood's observations recorded in Ent. Monthly Mag., xxix, p. 271 (1893), in which it was shown that the preservative influence was exerted by the young larva, so that, even if it died or disappeared, the effect remained; also that an analogous power, equally manifested in youth, was displayed by the larvae of *Lithocolletis*. To these discoveries Mr. Waters' observations recorded below were a most important addition, suggesting, with them, a biochemical problem of arresting interest.

" 20 *October*, 1925. I enclose the oak-leaf which I mentioned to you. This autumn I collected in Bagley Wood a good many larvae of the Phycid moth *Cryptoblabes bistriga* Hw., which make their living by gnawing the upper surface of oak-leaves and ultimately skeletonising them. I placed a

number of them in a tin with some oak-leaves, of which this was one. As you will see, there happened to be feeding in the leaf a larva of *Nepticula subbimaculella* Hw., then in a very small blotch against the mid-rib. A larva of *C. bistriga* gnawed the leaf systematically, but left a large space round the *Nepticula* mine severely alone; and in this space, which had turned a vivid green, the *Nepticula* larva completed its growth. It seems clear to me that the larva of *C. bistriga* found the area affected by the *Nepticula* larva to be distasteful, and that this can only have been due to the preservative which the latter injects (or exudes?) into the leaf. The effect is no longer so striking as it was a few days ago, as the *Nepticula* larva has greatly extended its blotch and quitted the leaf, and the edges of the green area have faded to brown. Nevertheless I think the leaf is still worth exhibiting. Two other leaves are enclosed, showing the work of larvae of the same two species."

A termitophilous fly from India.—Mr. F. W. Edwards exhibited specimens of a species of *Termitoxenia* near *T. heimi* Wasm., taken by Mr. H. G. Champion in nests of *Odontotermes obesus* in the Haldwani district, Kumaon, India, these being the first examples of this anomalous genus which had been received at the British Museum.

A Gynandromorph of Papilio androgeus.—Lord Rothschild exhibited two subspecies of *Morpho eugenia* Deyr.; *Morpho adonis* Cram. and a gynandromorph of *Papilio androgeus* Cram. and made the following remarks :—

"In illustration of my comments at the last meeting on Mr. Dicksee's exhibit, I have brought to-night two pairs of *Morpho eugenia eugenia* Deyr., from Guiana, and two pairs of *M. eugenia uraneis* Bates, from the Amazons. I have also brought up two pairs of the quite distinct species *M. adonis adonis* Cram., to illustrate the extraordinary resemblance between the ♀♀ of *adonis* and *eugenia*.

"The gynandromorph of *Papilio androgeus* shows a larger proportion of ♂ colouring than Mr. Dicksee's example exhibits, and as a corollary the genitalia show a different sexual

admixture. In Mr. Dicksee's example the coloration was mostly ♀ and the genitalia preponderatingly of that sex, the ♂ valves and harpes being quite abortive and practically absent; the penis alone being almost fully developed. In the specimen I exhibit there is a large area of ♂ coloration and a correspondingly larger admixture of ♂ armature in the genitalia, one valve and harpe being normally developed and the second one being also present though much smaller and abortive."

The following papers were read :—

1. "On the Butterflies of Jamaica," by Mr. W. J. Kaye.

2. "On a remarkable new Dragonfly from Samoa," by Major F. C. Fraser.

3. "On a new Psychid," by Mr. F. M. Jones.

4. "Contribution à la Faune des Orthopteres des Nouvelles-Hebrides, avec une introduction de John R. Baker," by C. Willemse. (Communicated by Professor E. B. Poulton, F.R.S.)

Wednesday, November 4th, 1925.

Prof. E. B. Poulton, F.R.S., President, in the Chair.

Election of Fellows.

The following were elected Fellows of the Society :—Dr. G. V. Bull, B.A., M.B., Montague House, Hoddesdon, Herts; Rev. J. G. Digges, M.A., Clooncahir, Mohill, Co. Leitrim; Wm. Fassnidge, M.A., 47, Tennyson Road, Southampton; Alfredo Faz, 714, Calle Bandera, Santiago, Chile; F. G. Holdaway, Zoological Dept., The University, Adelaide, S. Australia; Hamid Selim Soliman, Ministry of Agriculture, Cairo; Mohammed Soliman el Zoheivy, Ministry of Agriculture, Cairo; Rt. Rev. the Lord Bishop of St. Edmundsbury and Ipswich, The Bishop's House, Ipswich; R. Winckworth, 37, Upper Rock Gardens, Brighton; Commdr. G. C. Woodward, Training Ship "Cornwall," Purfleet, Essex.

Exhibitions.

Butterflies from the Pacific.—Mr. N. D. Riley exhibited a small selection from the Rhopalocera taken by members of the Scientific Expeditionary Research Association during the voyage of the "St. George." The specimens included three examples of an entirely new species of *Libythea*, from the island of Nuka Hiva, Marquesas; a race of the Hesperid *Badamia exclamationis*, also from the Marquesas; *Precis rillida*, from the Disappointment Islands; a male and five females of a species of *Jamides* (Lycaenidae) related to *J. walkeri*, from Rurutu, Austral Islands; and a single female *Candalides*, from Tahiti, with metallic green underside, also apparently quite new.

Commander J. J. Walker remarked that during his visit to the Marquesas Islands in 1883 he had observed the Hesperid and also the *Libythea*, but the latter he had not recognised as such, believing it to be the common *Atella* of Tahiti, which it closely resembles in flight and appearance. He never succeeded in capturing it. Although he knew of the existence of the *Precis* in the Central Pacific Islands, even at that time, he never saw a single living example during the entire voyage.

Mr. C. L. Collenette gave a brief account of the actual circumstances of the capture of these specimens.

A Tachinid parasite of Lycaenids.—Mr. J. E. Collin exhibited specimens of a Tachinid fly (*Exorista confinis* Fln.), bred from larvae of the last brood of *Cyaniris argiolus* (Holly Blue) collected at Eastbourne by Mr. R. Adkin in the autumn of 1922 and again in the present year, the fly in both cases emerging before the winter of the year of capture. Also a solitary female of the same species bred in July 1919 by Dr. E. A. Cockayne from *Thecla w-album*. In the case of *argiolus* this year quite 20 per cent. of the larvae were parasitised by the fly, but in *w-album* a large number of larvae only produced the one specimen of *confinis* and a few other parasites. Though not in the "List of British Diptera," *E. confinis* has been previously recognised as British by Mr. C. J. Wainwright. It appears to be a fairly common species

on the Continent and to attack chiefly the larvae of certain butterflies of the superfamily Ruralides (or Theclides), but in the list of hosts given in "Kertesz' Catalogue," *argiolus* is not included. It is also known to occur in N. America, where *Cyaniris pseudargiolus* (the American form of our *argiolus*) is found to be one of its hosts. The exhibitor raised the question as to how the autumn brood of this parasite of *argiolus* passes the winter. Do they hibernate, or is there some intermediate host from which another brood emerges in the spring?

Comments on this exhibit were made by Dr. Cockayne and Mr. Adkin, who described the conditions under which the larvae of *C. argiolus* were found.

A Swiss butterfly with distinct evidence of attack by a broad-billed bird.—The President exhibited a specimen of *Erebia aethiops* Esp., captured in August 1895, at Interlaken by his friend the late Prof. Raphael Meldola, F.R.S. The specimen, which was part of the collection bequeathed to the Hope Department in 1915, bore on the left fore-wing the clear marks of a bird's beak. The butterfly had evidently been seized at the posterior angle of the fore-wing and the wing bitten into as far as the terminal part of the cell, where the imprint of the tip of the bill was distinct. At the moment of seizure the apical section of the hind-wing was well covered by the fore so that it too shows the mark of the right side of the bill, and by making this mark coincident with the corresponding one on the fore-wing, the relative position of the wings at the time when the injury was inflicted could be restored.

Dr. Eltringham, after examining the specimen, suggested that the scales of Lepidoptera may, by their loose attachment, often cause a bird's bill to slip and thus lead to the escape of the insect.

A Siamese Ichneumonid (Pimplinae) probably mimetic of a Fossorial wasp (Pompilidae).—The President exhibited, on behalf of Mr. H. M. Pendlebury, a very fine female Ichneumonid. The iridescent dark-blue of the body and wings,

with their sharply contrasted transparent areas, suggested that the insect was a member of an association similar to the Bornean one described and figured by the late H. J. S. Pryer (Trans. Ent. Soc., 1885, p. 369, Pl. X, figs. 11, 12) and quoted by Wallace in his "Darwinism" (1889 ed., p. 259). This association included a Pompilid model and a Longicorn mimic.

Butterflies from Venezuela.—Mr. W. J. Kaye exhibited a series of the Ithomiine *Aeria agna*, together with a series of *Heliconius charithonia*. Both sets had been taken together at Caracas, Venezuela, at about 3200 ft. Attention was particularly drawn to the fact that the examples of *H. charithonia* were much smaller than from some other localities, such as Jamaica, where no similarly coloured Ithomiine was present. There was little doubt that the Caracas specimens belonged to a definitely small race. In May 1898 the exhibitor caught similar specimens to those taken in December 1920. The Ithomiine and the Heliconine when set and put side by side did not very greatly resemble one another, but on the wing at a short distance it needed some discernment to decide which was which. The smaller size of the Ithomiine was partly made up for by the greater area of yellow, while the marginal spots beneath of the hind-wing made some slight correspondence to the submarginal row of hind-wing spots in *H. charithonia*. In the same locality *Catonephele nyctimus* occurs, the ♀ of which would doubtless be a mimic of *charithonia* if not of *agna*. This note is in consequence of what Dr. H. Eltringham said in the Trans. Ent. Soc., 1916, p. 143: "It is remarkable that *H. charithonia*, perhaps the commonest species of *Heliconius*, should have no close imitators." It is most probable that to one who had never seen *Aeria agna* flying with *H. charithonia* the resemblance would not be appreciated.

Wednesday, November 18th, 1925.

Prof. E. B. Poulton, F.R.S., President, in the Chair.

Nomination of Officers and Council for 1926–27.

The Secretary announced that the Council had nominated the following as Officers and Council for 1926–27 :—

President : Prof. E. B. Poulton, M.A., D.Sc., F.R.S.
Treasurer : W. G. Sheldon, F.Z.S.
Secretaries : S. A. Neave, M.A., D.Sc., F.Z.S., and N. D. Riley, F.Z.S.
Librarian : H. J. Turner.
Council : Prof. W. A. F. Balfour Browne, M.A., F.Z.S., W. Bateson, M.A., F.R.S., G. C. Champion, F.Z.S., A.L.S., E. A. Cockayne, M.A., M.D., F.R.C.P., H. M. Edelsten, H. Eltringham, M.A., D.Sc., F.Z.S., J. C. F. Fryer, M.A., Prof. Sir T. Hudson Beare, B.Sc., F.R.S.E., K. Jordan, Ph.D., G. A. K. Marshall, C.M.G., D.Sc., F.R.S., W. Rait-Smith, H. Scott, M.A., ScD.

Election of Fellows.

The following were elected Fellows of the Society :—F. J. Killington, A.C.P., 1, St. Catherine's Road, Eastleigh, Hants; E. P. Mumford, Christ's College, Cambridge; A. J. A. Woodcock, M.Sc., Clifton Manor, York.

Change of Form of Transactions.

The President announced that, beginning with the coming year, the Council had decided to increase the size of the Transactions to super royal 8vo, with a printed page measuring $4\frac{3}{4} \times 7\frac{1}{2}$ ins.

Exhibitions.

Aberrations of British Butterflies.—Mr. L. W. Newman, on behalf of Mr. P. M. Bright, exhibited British Rhopalocera from the collection of the late Charles Oberthür, including a fine series of *Polyommatus dispar* and several remarkable aberrations, the most striking being an extremely light *Brenthis euphrosyne*, *Argynnis cydippe* with

the underside nearly all silver, and a specimen of *Gonepteryx rhamni* ♂ approaching the var. *cleopatra*.

Captures of insects, etc., on Nkosi, the southernmost island of the Sese Archipelago, N.W. Victoria Nyanza.—The President exhibited the specimens collected in 2½ hours by Dr. G. D. H. Carpenter and Mr. C. B. Symes during a visit last spring to Nkosi, the most remote island of its group. The immense preponderance of ants was well illustrated, together with its effect upon the rest of the collection, which was made up of species with habits which would defend against the attacks of ants. Only a single butterfly, a *Terias*, was seen. Speke's Tragelaph, the Situtunga, was present in numbers and, in the absence of enemies, had adopted the habits of a bush-buck and browsed away the undergrowth—a result which must have seriously affected the insect population. Further details will appear in a paper communicated to the Zoological Society on November 17.

Papers.

The following papers were read :—

1. "New Species of Staphylinidae from India, Part III," by Dr. M. Cameron.

2. "The Venation of the Hepialidae," by Mr. A. Philpott.

3. "Diptera from the Island of Rodriguez," by Professor Bezzi and Dr. C. G. Lamb.

4. "Defensive Colour and Pattern in four Caterpillars from British Guiana," by Mrs. H. H. Brindley. (With an Appendix by the President.)

5. "On the Presence of an Egg-burster in Aphididae," by Mr. G. T. Gimingham.

Mr. Gimingham showed lantern slides illustrating his paper.

The President exhibited lantern projections illustrating Mrs. Brindley's paper and its appendix. Among the examples were a S. Nigerian Sphingid larva adopting a terrifying Cobra-like attitude, photographed from life by Mr. A. W. J. Pomeroy; the eye-like marks shown to project in the same attitude

when assumed by a S. American Nymphaline larva (*Prepona*) photographed by Mrs. Brindley, and a Nairobi Sphingid (*Centroctena rutherfordi* Druce) by Dr. V. G. L. van Someren. Also two S. American Sphingid larvae of the genus *Leucorhampha*, figured by the Rev. A. Miles Moss, one of which was almost certainly the snake-like caterpillar described by H. W. Bates in the classical paper which appeared in Trans. Linn. Soc. Lond. (vol. xxiii, p. 509) in 1862. This caterpillar was, because of its attitude, supposed by Rev. Joseph Greene to be a Notodont, but Mr. Miles Moss's figures reproduced in Nov. Zool. xxvii (1920) clearly showed that it was characteristic of these snake-like Amazonian Sphingids. Mrs. Brindley's photograph from life of a spider-like Limacodid caterpillar from British Guiana and Mr. A. J. Nicholson's of the Australian Limacodid *Doratifera vulnerans* Lewin, at rest and after disturbance, were also projected on the screen.

Wednesday, December 2nd, 1925.

Mr. W. Bateson, F.R.S., Vice-President, in the Chair.

Nomination of Officers and Council.

The Secretary read for the second time the nominations for Officers and Council for 1926–27.

Obituary.

The Chairman announced the death of Mr. E. A. Butler.

Election of Fellows.

The following were elected Fellows of the Society:—R. B. Benson, B.A., St. Catherine's College, Cambridge; H. G. H. Kearns, B.Sc., Downing College, Cambridge; and Miss C. Longfield, 20, Pont Street, London, S.W. 1.

Exhibitions.

Varieties of British Lepidoptera.—Dr. G. V. Ball exhibited bred varieties of *Trichiura crataegi*, from Essex, *Abraxas grossulariata* var. *inframarginata* from Herts and *Saturnia pavonia* from Yorkshire.

Mimicry of an Inflorescence by Coreid Bugs.—Miss L. E. Cheesman exhibited nymphs of a Coreid taken during the St. George Expedition at Taboga Island ten miles from Panama, with a sketch showing them clustered on a small leguminous tree. The group resembled a spike of brightly coloured flowers from a short distance, especially as four of the bugs had placed themselves symmetrically so that they appeared to be a blossom with four petals.

A Beetle new to Britain.—Dr. N. H. Joy exhibited an example of *Bembidion redtenbacheri* K., taken near Sheffield, September 1925, and evidently not an importation.

Dr. A. D. Imms gave an interesting account, with lantern slides, of an entomological visit to the Hawaiian Islands.

Prof. Bateson and Dr. H. Scott took part in the discussion that followed, the latter drawing comparisons between the character of the insect fauna of Hawaii and that of the Seychelles.

Papers.

The following papers were read :—

1. "Parthenogenesis of *Methoca ichneumonides* Latr. (Hymenoptera, Vespoidea)," by Mr. H. T. Pagden. (Communicated by Dr. H. Scott.)

2. "On Walker's types of Plume-moths in the National Collection: Redescriptions and Notes," by Mr. T. Bainbrigge Fletcher.

ANNUAL MEETING.

Wednesday, January 20th, 1926.

Mr. W. Bateson, Vice-President, in the Chair.

Dr. S. A. Neave, one of the Secretaries, read the following:

The Council is again able to report steady progress in the Society's various activities during the year.

The financial position will be dealt with separately in the Report of the Treasurer.

The Society has lost rather more Fellows than usual from various causes during the year, 13 having died, 15 having resigned, 6 having been removed for non-payment of subscription, and 1 not having taken up his Fellowship. There has, however, been a slight increase in the number of new Fellows elected, 38 as compared with 34 last year. The Society now consists of 11 Honorary, 2 Special Life, and 703 ordinary Fellows, a total of 716, which, although only showing a small increase, is again the largest in the history of the Society.

The Council has received with great regret the resignation of Dr. Eltringham from the post of Transactions Secretary, but they are happy to be able to announce that Mr. N. D. Riley has consented to be nominated to take his place.

The volume of Transactions and Proceedings, though not quite so large as that for 1924, which was an abnormal one, is nearly as fully illustrated, and will consist of 639 pages, comprising 27 papers by the following authors :—

G. T. Bethune-Baker, 1; Professor Bezzi and Dr. Lamb, 1; Mrs. Brindley and Professor Poulton, 1; Dr. M. Cameron 1; Dr. Cockayne, 1; W. C. Crawley, 1; C. S. Elton, 1; Dr. H. Eltringham, 5; T. Bainbrigge Fletcher, 1; Dr. F. C. Fraser, 1; C. T. Gimingham, 1; Major Graves, 1; F. M. Jones, 1; W. J. Kaye, 1; K. J. Morton, 1; H. T. Pagden, 1; A. Philpott, 2; L. B. Prout, 1; N. D. Riley, 1; Dr.

Singh Pruthi, 1; B. P. Uvarov, 1; C. Willemse, 1. Of these, 16 deal with Lepidoptera, 2 each with Rhynchota, Hymenoptera, Neuroptera and Orthoptera, 1 each with Coleoptera and Diptera, and 1 is of a general character. The volume is illustrated by 55 plates, 2 of which are in colour, 37 are line-block, and 16 are half-tone. The original illustrations in all cases have been provided by the authors. The Society received a substantial contribution from the Royal Society towards the cost of Dr. Singh Pruthi's paper; and Major Graves contributed towards the cost of his plates; Sir George Kenrick presented the coloured plate for Mr. Prout's paper, and Mr. Morton presented the block for his half-tone plate.

The Proceedings will consist of 75 pages and be illustrated with 4 half-tone plates, all of which have been presented by Professor Poulton.

By a recent resolution of the Council, which was announced at the General Meeting held on 18th November last, it has been decided to change the form of the Society's publications, beginning with the volume for 1926. The size will be increased to Super Royal 8vo, with a printed page of $4\frac{3}{4}''$ by $7\frac{1}{2}''$, and the volume, which will be the 74th of the whole series of the Society's publications, will bear that number as well as the year of publication.

The detailed work of the Society's business has been carried on by a Finance and Housing Committee under the chairmanship of Mr. G. T. Bethune-Baker, a Publications Committee under that of Mr. J. E. Collin, and a Library Committee under that of Dr. K. Jordan. The thanks of the Council are again due to the Fellows serving on these Committees for their valuable assistance.

The Librarian reports that the work of re-arrangement of the separates and their identification with the card index is slowly making progress as available time occurs. Fellows are again asked to remember the Society's Library when they have duplicate volumes or separates to spare. An attempt will be made during the coming year to add to the number of purely entomological periodicals in order that in time all such may be found on the Library table month by month.

The arrears of binding are now well in hand, and it is hoped that by the end of the coming year the work of re-binding will have been reduced to normal dimensions.

The Report was adopted on the motion of Mr. H. Willoughby Ellis, seconded by Mr. S. Edwards.

The Treasurer's Report.

The Treasurer then read the following Report :—

A year ago I ventured to forecast that during 1925 the Society would be able to redeem the remaining Debentures, amounting to £510. These were redeemed at the end of March last, and we then became once more entirely free of debt.

The total amount of the fund that was raised for the purchase and fitting up of our home was £8,471 10*s.* 6*d.*, and the details of the receipts are as follows :—

	£	*s.*	*d.*
Received by Donations	4,823	9	0
do. Bequests	1,150	0	0
Savings out of Income	2,436	8	11
Received by Interest from money on Deposit at Bank	61	12	7
Total	£8,471	10	6

It is an achievement of which any Society might be proud, that this sum was liquidated in a period of a little over four years.

Towards the donations 248 Fellows contributed. The number of bequests was two.

Perhaps the most surprising feature, when one considers the financial position a few years ago, is the amount, £2,436 8*s.* 11*d.*, saved by the Society out of its income during the period of the liquidation. This most satisfactory result arises because all but about thirty of the Fellows elected before 1921, in their desire to assist the Society, agreed to pay the maximum subscription of Two Guineas per annum, nstead of the old subscription of One Guinea per annum,

and even amongst those who did not pay the maximum subscription, quite a number made donations, so we may say that practically the whole of the Fellows assisted the Society in its necessity, and are responsible for its present prosperity.

I am sure it will be felt more and more as time goes on how much posterity owes to those who have so generously assisted the Society in its effort to provide a home that is worthy of it, of its great traditions, and its undoubted future.

In 1925, as in 1924, only to a still greater extent, the most remarkable increase in receipts has been the amount realised by the sale of our publications, the total receipts from this source having been the sum of £639 7*s*. 1*d*., or £138 9*s*. 6*d*. more than last year's record. I do not know anything that could more eloquently testify to the Society's enhanced reputation than these annual increases.

Admission Fees are £6 6*s*. less in 1925 than in 1924, but this is owing to special circumstances: the number of Fellows elected in 1925 is four more than the number elected in the previous year.

Donations in aid of the publications include £100 from the Royal Society, £30 from Mr. G. T. Bethune-Baker, and donations from Sir G. H. Kenrick (£15 3*s*.) and Major P. P. Graves (£14 18*s*.). The thanks of the Society are due to these donors for their much-appreciated gifts.

A bequest of £100 was received from the executors of the late Mr. A. H. Jones.

The amount spent upon the Publications was slightly more than in the previous year, £934 1*s*. 6*d*. in place of £913 18*s*. 1*d*.

The expenditure upon new books for the Library was £127 4*s*. 8*d*., a sum I hope our resources will enable us to at least allot to this laudable purpose annually in future years.

The cost of repairs to premises, as in 1924, was again heavy; we had to spend £173 18*s*. 1*d*. on this item, principally owing to the roof requiring the slates refixing, and the parapets cementing. The building is now in a good state of repair, and for the next few years the reparations should cost little.

The sum of £413 8*s*. 8*d*. was transferred from the General

Account to a new Fund opened during the year. I refer to this later.

In spite of our large and adequate expenditure on all the usual items of our programme, the Society is so prosperous that after allowing for all current obligations that can be traced, the estimated excess of income over expenditure amounts to the large sum of £563 2*s*. 9*d*., easily a record surplus in the history of the Society.

Our invested funds, which a year ago amounted to £8,266 4*s*. 1*d*., are now valued by the Auditors at £9,170 19*s*. 4*d*., an increase in value during the year of £904 15*s*. 3*d*.

The net excess of assets over liabilities is £10,198 15*s*. 8*d*., not including the Library and furniture. The value of these is certainly not under £5,000; probably they are worth considerably more than this sum.

Our portrait gallery has been added to during the year by the very interesting portrait of our first President, J. G. Children, who may, perhaps, more than any other, be styled the Father of the Society, because, apart from his Presidency, he was prominently associated with its formation, and it was at a meeting held at his house that the decision was arrived at that it should be formed. The other portraits hung during the year are those of A. W. Bacot, W. L. Distant and Hamilton H. C. Druce.

The portraits of a large number of entomologists, well known in their day, but not especially distinguished in the history of the Society, have been obtained and mounted in albums. They are available for inspection at the Society's Rooms on application to the Librarian.

I now come to a feature in our programme we have had in mind for some time; it is one that I feel sure will require our best efforts during the next few years, and that will be worthy of them. I allude to the project I touched upon in my last Report, the formation of a new Meeting Room, and the transference of the Library to the present Meeting Room.

I have had estimates prepared of the cost of these operations, and find that at present prices the alterations involved by the formation of a New Meeting Room and cloak-room accommodation would cost about £3,800, and that suitable

bookshelves and furniture for the New Library would cost a further £700, or a total of about £4,500.

The important question for consideration is, How can this scheme be financed and carried out with the greatest advantage to the Society?

Of course we would all like to have our new Meeting Room and Library at the earliest possible moment, say this year, but I do not advocate that this course should be adopted at present, for the following reasons.

Although the tenancy of the garage at the rear of the premises, which we propose to include in the Meeting Room, does not expire until Michaelmas 1928, it has been suggested that possibly we might obtain a surrender of the lease by the holder at an early date. This might be possible, but I am afraid we should have to pay a substantial sum for the concession.

If we commence building this year we must at once raise the required sum of £4,500. We might do this in part by making an appeal to the generosity of the Fellows, but I am afraid this is not a very suitable time for an appeal, and in the absence of one the only resource open to us is to raise the money by issuing Debentures, redeemable as our means allow: but we should have to pay interest on them, and this would represent a considerable annual sum. We should also be without the income arising out of the rent of the garage, amounting to £140 per annum. It will be seen that our income, out of which we should mainly have to redeem the Debentures, would, by these changes, be reduced by a large amount, and in view of this it would in all probability be a number of years before we were again free of debt.

There is the further objection to starting operations at present, that the scarcity of labour is so great in the building trade, the alterations would take a far longer period to carry out than in normal times, with, of course, much inconvenience to the Society and its tenants.

The other method, and one I strongly recommend, is to commence the alterations in May or June 1929, so as to get them completed in the summer recess of that year. I think this might be accomplished, because by then the National

Housing problem should be less acute, and this would free large numbers of operatives for other departments of building.

By adopting this method there is every prospect that we should have ready, at any rate the bulk of the money required, which could be saved out of our surplus income.

Already a start has been made to provide finances on these lines, for during the past year the substantial sum of £413 8*s*. 8*d*. was set aside and has been invested in 5 per cent. National War Bonds 1929. These bonds are redeemable early in that year, so there will be no risk of depreciation of capital when it is required. If, as I hope, the Council will allow me to devote the surplus income over expenditure available at the end of 1925 to this fund, we shall already have almost one thousand pounds set aside to meet our requirements.

I feel that it is of great importance to the Society that the obligations involved by this scheme should be liquidated at the earliest available moment for various reasons, the principal one being the desirability that the Society should have a larger staff as soon as possible, and that, of course, will mean a considerable additional expenditure in salaries.

It is now just a quarter of a century since the late G. H. Verrall in his presidential address strongly advocated the appointment of a paid secretary. Verrall had an excellent knowledge of organisation, and it does not appear that his advice was anything but sound. There is no doubt that a permanent secretary would add greatly to the stability of our Society; all the large scientific Societies have one or more of these officials on their establishment, and they are regarded as being essential to their welfare.

Since Verrall wrote, the scope and complexity of the officers' duties have very much increased, so much so, in fact, that it is very difficult for them to find sufficient leisure to carry out their work for the Society, and I am sure that it is to its welfare that they should be relieved of much of it by the appointment of a permanent official.

These suggestions may seem to some of us ambitious, but the undertakings we have recently carried through successfully were more arduous, and they were accomplished with far less resources than we at present possess.

Some years ago, I think it was in 1920, I had occasion to visit the Linnean Society at Burlington House. We were just then seriously considering our own housing problem, and I viewed with much interest and approval the extremely beautiful rooms of this Society. I strolled through the Meeting Room, and gazed with admiration at the wonderful array of portraits of eminent Fellows, and the well-designed and luxurious fittings and decorations. I then mounted the handsome staircase and entered the Library on the first floor, certainly one of the most beautiful I had ever seen, lofty, handsomely fitted, and with ample space for the books. Throughout the whole suite there was an air of the refinement and beauty that ought to surround a great Society.

Immediately after leaving Burlington House I proceeded to our old head-quarters at 11 Chandos Street. I sat down in the Library, our only private room, and looked around. This is what I saw. A room about twenty feet square and perhaps nine feet high, the walls covered with bookshelves from floor to ceiling, and every available foot of floor space similarly occupied. The books themselves were crowded into the shelves, and in many cases were two, and in some cases three tiers deep. So crowded, in fact, were they that it did not seem practicable for the Society to purchase additional books because there was no available space to stow them in.

The books were so congested that it was impossible to free them properly from the dust and dirt, and from this cause, and from the overcrowding, both books and bindings were seriously depreciating.

I do not think anything had been done, or could have been done because of the congestion, to renew the paint or distemper of the room since the Society had entered into possession of it more than thirty years previously. The whole surroundings were certainly not worthy of the Society and the science of entomology.

We have travelled a long distance in the right direction since then, but I do not think we have yet arrived at our ideal destination, and I trust we shall not rest satisfied with our present position, or anything near it. There are some words of a great poet the spirit of which I should like to have

adopted as applicable to the future of our Society. They teach us that "men rise on stepping-stones of their dead selves to higher things." I trust that we shall keep in memory the surroundings of the Burlington House Societies, and that we shall improve those of our own Society, step by step, until we have ultimately arrived at their standard.

The Report and Accounts were adopted on the motion of the Rev. G. Wheeler, seconded by Comm. Walker.

It was announced from the Chair that the Fellows nominated as Officers and Council for the ensuing year had been duly elected in accordance with the Bye-laws.

In the absence of the President, Prof. E. B. Poulton, F.R.S., his Address was read by Dr. S. A. Neave, and at its conclusion a vote of thanks to the President, coupled with a request that the Address might be printed in the Proceedings, was moved by Mr. J. E. Collin, seconded by Dr. H. Scott, and carried unanimously.

A vote of thanks to the Officers for their services during the year was then passed on the motion of Dr. K. Jordan, seconded by Prof. Balfour Browne, and Mr. W. G. Sheldon, Dr. S. A. Neave and Mr. H. J. Turner briefly replied.

TREASURER'S ACCOUNTS for the Year ended December 31, 1925.

(Presented at the Annual Meeting, January 21, 1926.)

RECEIPTS AND PAYMENTS ACCOUNT.

Receipts.	£ s. d.	£ s. d.
To Cash at Bank and in hand, as per last Account—		
General Account	911 14 9	
Compounding Fund	49 16 3	
Library Fund	26 2 7	
Donations for Specific Purposes	108 6 8	
		1,126 0 3
„ Interest on Investments—		
Birmingham 3% Stock	7 3 8	
Consols	35 15 0	
National War Bonds	29 2 7	
„ Interest—		
Hamilton Druce Bequest	39 8 11	
„ Interest on Deposit—		
General Account	22 4 11	
„ Rents from Sub-tenants	390 0 0	
		523 15 1
„ Contributions by Tenants towards House Expenses		160 7 2
„ Admission Fees		100 16 0
„ Annual Subscriptions—		
Arrears	75 12 0	
1925	1,191 8 0	
Advance	25 3 11	
		1,292 3 11
(Subscriptions for 1925 received in 1924, £54 11s.)		
„ Sales of Publications		639 7 1
„ Donations in aid of Publications		149 1 7
„ Miscellaneous Receipts		7 19 9
		£3,999 10 10

Payments.	£ s. d.	£ s. d.
By Salaries		353 18 9
„ Library—		
New Books	127 4 8	
Binding, Repairs and Insurance	23 11 3	
		150 18 11
„ Cost of Publications—		
Printing and Distribution	709 2 10	
Illustrations	224 18 8	
		934 1 6
„ Sundry Printing and Stationery		30 14 4
„ Postage		23 19 0
„ Audit Fee		10 10 0
„ Donation to Zoological Record		25 0 0
„ Entrance Fee paid out of Donation		3 3 0
„ Miscellaneous Expenses		45 4 8
„ Law Costs		42 17 3
„ House Expenses—		
Fuel, Gas, and Electric Light	86 4 4	
Insurance	10 9 6	
Water	13 2 4	
Repairs	173 18 1	
Sundry Expenses	57 12 5	
		341 6 8
„ Interest on Debentures (less tax)	9 17 8	
„ Income Tax thereon	2 17 4	
		12 15 0
„ Transfer to Housing Fund		488 11 1
„ Transfer to New Meeting Room Fund		307 14 8
„ Purchase of £50 5s. 6d. National War Bonds, 1928		53 8 10
„ Cash at Bank and in Hand—		
General Account	1,027 11 6	
Westwood Bequest Fund	7 3 8	
Compounding Fund	46 15 5	
Library Fund	18 16 7	
Donations for Specific Purposes	75 0 0	
		1,175 7 2
		£3,999 10 10

STATEMENT OF ASSETS AND LIABILITIES—DECEMBER 31, 1925.

Assets.	£ s. d.	£ s. d.
To Freehold Premises, 41 Queen's Gate, S.W., Cost of Purchase...		6,250 0 0
„ Library, Furniture and Fittings ...	Not valued *	
„ Present value of—		
£1,354 2*s.* 2*d.* 2½% Consols (Compounding Fund—Cost £1,233 3*s.*)	744 15 0	
£609 19*s.* 3*d.* 5% Nat. War Bonds 1928 (Compound. Fd.—Cost £614 15*s.* 1*d.*)	641 19 6	
£239 12*s.* 4*d.* Birm. Corp. 3% Stk. 1947 (Westwood Bequest Fd.—Cost £250)	150 19 2	
£1,095 15*s.* 6*d.* N.Z. 4% Stk. 1943–63 (H. Druce Beq. Fund—Cost £1,000)	964 5 8	
£400 5% Nat. War Bonds 1929 (New Meeting Room Fund—Cost £417 1*s.*)	419 0 0	
		2,920 19 4
„ Amounts due to the Society—		
Subscriptions	116 0 0	
Admission Fees	15 15 0	
Publications	36 13 10	
Rents and Contr. to House Expenses	172 10 0	
Sundries	4 11 5	
	345 10 3	
Less not considered good	25 0 0	
		320 10 3
„ Cash at Bank and in Hand—		
General Account:		
Current Account 212 7 4		
Deposit Account 817 0 0		
	1,029 7 4	
Less Due to Secretary ... 1 15 10		
	1,027 11 6	
Compounding Fund—Current Account	46 15 5	
Library Fund—Current Account ...	18 16 7	
Westwood Bequest Fund—Curr. Acc.	7 3 8	
Don. for Specific Purposes—Curr. Acc.	75 0 0	
	1,175 7 2	
Less Overdrawn at Bank—Current Account, New Meeting Room Fund	3 12 4	
	1,171 14 10	

Liabilities.	£ s. d.	£ s. d.
By Amounts Due from the Society—		
Printing Transactions, Parts III, IV, and V	379 13 9	
Sundry Accounts	51 3 1	
		430 16 10
„ Subscriptions received in Advance ...		33 11 11
„ 5% Debentures—		
Issued to provide for Purchase of 41, Queen's Gate, S.W.:		
As at 1st January, 1925	510 0 0	
Less Repaid during year ...	510 0 0	
„ Excess of Assets over Liabilities—		
General Account	879 5 4	
Donations for Specific Purposes	75 0 0	
Housing Fund	6,250 0 0	
New Meeting Room Fund... ...	415 7 8	
Compounding Fund	1,433 9 11	
Library Fund	23 4 3	
Westwood Bequest Fund	158 2 10	
Hamilton Druce Bequest Fund...	964 5 8	
		10,198 15 8

STATEMENT OF EXCESS OF ASSETS OVER LIABILITIES—DECEMBER 31, 1925.

General Account.	Assets. £ s. d.	Liabilities. £ s. d.
Sundry Amounts due to Society ...	316 2 7	
Cash at Bank and in Hand	1,027 11 6	
Sundry Amounts due from Society		430 16 10
Subscription in Advance		33 11 11
Excess of Assets over Liabilities		879 5 4
	£1,343 14 1	£1,343 14 1

Housing Fund.	£ s. d.	£ s. d.
Freehold Premises	6,250 0 0	
Excess of Assets over Liabilities		6,250 0 0
	£6,250 0 0	£6,250 0 0

Compounding Fund.	£ s. d.	£ s. d.
Investments at Valuation	1,386 14 6	
Cash at Bank	46 15 5	
Excess of Assets over Liabilities		1,433 9 11
	£1,433 9 11	£1,433 9 11

Library Fund.	£ s. d.	£ s. d.
Amount due to Society	4 7 8	
Cash at Bank	18 16 7	
Excess of Assets over Liabilities		23 4 3
	£23 4 3	£23 4 3

Westwood Bequest Fund.	Assets. £ s. d.	Liabilities. £ s. d.
Investment at Valuation	150 19 2	
Cash at Bank	7 3 8	
Excess of Assets over Liabilities		158 2 10
	£158 2 10	£158 2 10

Druce Bequest Fund.	£ s. d.	£ s. d.
Investment at Valuation...	964 5 8	
Excess of Assets over Liabilities		964 5 8
	£964 5 8	£964 5 8

New Meeting Room Fund.	£ s. d.	£ s. d.
Investment at Valuation	419 0 0	
Cash at Bank Overdrawn		3 12 4
Excess of Assets over Liabilities		415 7 8
	£419 0 0	£419 0 0

Donations for Specific Purposes Unspent.	£ s. d.	£ s. d.
Cash at Bank	75 0 0	
Excess of Assets over Liabilities		75 0 0
	£75 0 0	£75 0 0

HOUSING FUND (TOTAL RECEIPTS AND PAYMENTS TO DECEMBER 31, 1925).

Receipts.

	£	s.	d.
To Balance at Bank as per Last Account	22	8	11
,, Transfer from General Account	488	11	1
,, Donations	1	1	0
	£512	1	0

Payments.

	£	s.	d.
By Repayment of Debentures	510	0	0
,, Balance transferred to New Meeting Room Fund	2	1	0
	£512	1	0

NEW MEETING ROOM FUND.

	£	s.	d.
To Transfer from Housing Fund	2	1	0
,, Transfer from General Account	307	14	8
,, Bequest—The late A. H. Jones, Esq.	100	0	0
,, Donation	1	1	0
,, Interest on War Bonds	2	12	0
,, Balance at Bank, overdrawn	3	12	4
	£417	1	0

	£	s.	d.
By Cost of £400 5% National War Bonds 1929 ...	417	1	0
	£417	1	0

HOUSING FUND FOR PURCHASE OF NO. 41, QUEENS GATE, S.W.

	£	s.	d.	£	s.	d.
To Donations	4,973	9	0			
,, Transfers from General Account ...	3,436	8	11			
,, Bank Interest	61	12	7			
				8,471	10	6
				£8,471	10	6

	£	s.	d.	£	s.	d.
By Cost of Premises	6,250	0	0			
,, Legal Expenses	298	1	0			
,, Interest on Purchase Money	26	16	2			
,, Surveyors' Fees	92	0	5			
,, Repairs and Alterations	1,118	3	11			
,, Removal of Library	207	9	8			
,, Furnishing	411	2	2			
,, Sundries	65	16	2			
				8,169	9	6
,, Balance transferred to New Meeting Room Fund				2	1	0
				£8,471	10	6

WESTWOOD BEQUEST FUND.

Receipts.	£	s.	d.	Payments.	£	s.	d.
To Interest on £239 12*s.* 4*d.* Birmingham 3% Stock ...	7	3	8	By Balance at Bank at date	7	3	8

LIBRARY FUND.

	£	s.	d.		£	s.	d.
To Balance at Bank, January 1, 1925	26	2	7	By Expenditure on New Books	127	4	8
„ Interest—Hamilton Druce Bequest	39	8	11	„ Balance at Bank at date	18	16	7
„ Transfer from General Account	30	1	9				
„ One-half of Admission Fees received in 1925 ...	50	8	0				
	£146	1	3		£146	1	3

COMPOUNDING FUNDS.

	£	s.	d.		£	s.	d.
To Balance at Bank, January 1, 1925	49	16	3	By Investment in £50 5*s.* 6*d.* 5% National War Bonds, 1928	53	8	10
„ One-half of Admission Fees received in 1925 ...	50	8	0	„ Balance at Bank at date	46	15	5
	£100	4	3		£100	4	3

NEW MEETING ROOM FUND.

	£	s.	d.		£	s.	d.
To Receipts in 1925	413	8	8	By Amount Invested in 1925	417	1	0
„ Balance at Bank overdrawn at date	3	12	4				
	£417	1	0		£417	1	0

REPAIRS TO PREMISES FUND.

	£	s.	d.		£	s.	d.
To Amount transferred from General Account ...	173	18	1	By Payments for Repairs to Premises	173	18	1

W. G. Sheldon, *Treasurer.*

We have audited the Treasurer's Accounts of Receipts and Payments and the Statement of Assets and Liabilities with the Books and Vouchers of the Society, and certify them to be correct. We have inspected the Deeds of the Property, and have verified the other Investments and Bank balances.

28, *Queen Victoria Street, London, E.C.* 4.
January 19, 1926.

W. B. Keen & Co., *Chartered Accountants.*

THE PRESIDENT'S ADDRESS

Ladies and Gentlemen,

The position of the Society and its growth in influence and security during recent years are, I am sure, a source of great satisfaction to the Fellows. We have paid off during the past year the remaining Debentures, amounting to £510. Towards the provision of the one great want of the Society—a commodious and well-proportioned meeting-room, and such an admirable library as the existing meeting-room will supply, —towards these great needs we have invested £400, and, thanks to the large amount of the sales, over £600, it is anticipated that there will be a further addition of £150 or £200. The Treasurer will shortly obtain estimates for the cost of the new meeting-room and fittings for the library. We may enter upon these great undertakings without any misgivings; for we shall be guided in the future as we have been in the past by the experience of the Treasurer, who I hope realises the fullness of our confidence and the depth of our gratitude for all that he has done for the Society.

In expressing our gratitude to the Officers for their invariable courtesy and devotion to the interests of the Society, I wish especially to thank Dr. Eltringham for the standard he has left for his successors, and to assure him of the regret which we all feel that his term of office has come to an end.

The Society has lost thirteen of its Fellows during the past year, including our distinguished Hon. Fellow, Professor B. Grassi, whose discovery of the transformations and life-history of the eel—that insoluble mystery of the ancient as well as the modern world—must always remain as one of the great landmarks of Zoological Science. Future generations will securely apportion the credit among those who have taken part in the immensely fruitful discovery of the malarial organism in its relation to *Anopheles* and to man, but it is certain that

Grassi's share will be great; some indeed think that it will be the greatest of all. Again, what investigations could be more interesting or more hopeful, as pointing the road to fruitful research in the future, than Grassi's work upon the causes which produce the castes of Termites?

Of the twelve Fellows who will, to our great regret, be absent from the list, several were known to me personally, and many are known from the memories which their friends have placed on record.

James E. Black,* F.L.S., beginning as a lepidopterist, became an enthusiastic student of British Coleoptera and also of the Cetoniidae of the world. His friends will long remember his kindness and charming personality. He was elected a Fellow in 1904.

Henri Boileau, elected in 1911, was well known to English entomologists as an eminent student of the Lucanidae and an amiable and friendly comrade with whom it was a pleasure to work.

Dr. A. G. Butler,† for many years the head of the Insect Department of the Natural History Museum, has left a deep and enduring mark on the systematics of our subject, especially in the Rhopalocera. His wide interest, as he ranged from group to group, was—so I was told by Professor Westwood—humorously expressed by the friendly nickname of "Flutterby," while his favourite insects were quite naturally called "Butlerflies." It must not be supposed, however, that he had no preferences. He once told me that he particularly disliked the Papilios—"vulgar things" he called them. Another memory comes back—his words of keen resentment at the conduct of a naturalist visiting the Department. It was not so much that he had dropped a drawer of valuable specimens as that he had himself set to work to sort out and re-affix the fragments, which lay like a heap of spillikins in one corner—this was the unforgivable sin! "Why, I would not have ventured to mend a specimen myself," he said. "Our attendants begin as boys and gain a delicacy of touch which none of us can hope to possess." His indignation had led him on into a pleasant

* Ent. Monthly Mag., lxi, pp. 208, 209. Entomologist, lviii, p. 232.
† Entomologist, lviii, pp. 175, 176. Ent. Monthly Mag., lxi, p. 167.

recognition and appreciation of the work of others. Dr. Butler was elected in 1868, and was thus one of the most senior of our Fellows.

We have lost in E. A. Butler,* elected in 1883, an entomologist who took a broad view of his subject, studying the life-histories of the British Hemiptera with care and patience, and bringing the results of this fascinating side of his work to bear on other lines of enquiry. His work is all the more valuable because it was concentrated upon a group studied by comparatively few entomologists. It is very fortunate for entomological science that he was able to bring together and make available for future workers the splendid results he achieved in his favourite study. The "Biology of the British Hemiptera-Heteroptera" is his enduring monument.

Many entomologists will remember Arthur Cant † with his wonderful dexterity and ingenuity, working at the great Godman-Salvin Collection in Chandos Street, close to the old quarters of the Society, and later in charge of the setting-room of the Natural History Museum. They will think of him as one who was always ready to help others from the store of his own great experience. He had been one of our Fellows since 1889.

John Williams Hockin,‡ who joined the Society in 1917, went to India as a coffee-planter in the Wynaad district of the Madras Presidency, in 1872, remaining until the "leaf disease" and falling markets had ruined many of the estates. He then in 1902 became partner in a firm contracting for the Peryar Irrigation Project in Travancore, and was engaged on similar work until his retirement in 1916. He was thus for over forty years in the jungle on the Western Ghats or among the foothills of the Cardamum Range, and for the last fourteen years had access to an excellent library. The birds first aroused his interest in natural history. He did not care to collect them, but recorded the results of his observations in some of the Indian journals. His keen interest in insects, especially butterflies, arose out of the wish to please his son, who, away at school

* Ent. Monthly Mag., lxi, p. 280; lxii, p. 24.
† Entomologist, lviii, p. 72. Ent. Monthly Mag., lxi, p. 48.
‡ I am indebted to Mrs. E. I. Carlyle of Oxford, our late Fellow's daughter, for these details of her father's life in India.

in England, longed for specimens from the tropics. Entomology thus became his chief interest in India and after his return home. He had a thorough and extensive knowledge of the habits of the S. Indian butterflies. A few of his observations are recorded in our Proceedings, and his notes on the very rare *Parantirrhoea marshalli* Wd.-Mas., which he knew more intimately than any other entomologist, will, I hope, soon be published. He often regretted that, during his life in India, he had not been more in touch with naturalists at home. To help our comrades far away in other lands, and to receive the help which they are able and willing to give, is one main function of our Society. No one can think that it is neglected —far from it—but the more we can do the better for our distant friends and for our science.

Such widespread sympathy was expressed at the tragic death of Professor Harold Maxwell-Lefroy * that it is unnecessary to say again what has been said by many and deeply felt by all. Maxwell-Lefroy will always be remembered with Arthur Bacot as one of the band of workers who have given their lives for science and for mankind. He was elected a Fellow in 1900.

J. R. H. van der Poll, a Fellow since 1885, was well known in this country for the variety and extent of his collections, chiefly from the Dutch East Indies, but also others of historic interest. Several years ago the collections of every kind were offered for sale in this country, when fortunately it became possible to secure the preservation of some of them intact. The most valuable part of the vast series of Malayan Rhopalocera was bought for the Adams Collection, now in the Natural History Museum.

The past year has been memorable as the centenary of the birth of Thomas Henry Huxley and Henry Walter Bates. We owe to Huxley that liberty in the free expression of scientific thought which seems so natural that future generations and even some of us to-day may find it hard to realize how stern was the struggle and how deep the debt that is owing. It is due

* Entomologist, lviii, pp. 279, 280. Ent. Monthly Mag , lxi, pp. 259, 260.

to Huxley far more than to any other man that recent events in Tennessee which have aroused the wonder and ridicule of the world would be an impossibility in this country.

It is unnecessary here to say anything of H. W. Bates, one of the greatest names associated with our Society and one that will always be historic, not only on account of classical researches in different departments of our science, but as the friend and fellow-traveller of Alfred Russel Wallace. Whether Wallace would have been an entomologist if he and Bates had never met we cannot tell; but we do know that his first interest was aroused by Bates when their friendship began at Leicester in 1844.

A book of outstanding interest which appeared in 1924 is the "Life of Lord Rayleigh," by his son. I trust that those Fellows who have not seen it will take the opportunity of learning something of one who was the ideal of all that a scientific man should be—rich in imagination, yet never satisfied until he had tested and retested with boundless patience and attention to detail the hypotheses he had created; always modest about his own achievements, appreciative of the discoveries of others, and hesitating to join in an adverse verdict which most scientific men were ready and indeed eager to deliver.

One example of his caution brought to me the memory of words spoken nearly thirty-six years ago, and these lead on by a natural sequence to my main subject to-night. The present Lord Rayleigh writes on p. 45 :—

"I had been reading the *Origin of Species* about 1906, and remember asking him whether, on the whole, he could accept natural selection as a sufficient explanation of evolution. 'Well, no,' he said, 'I don't think I can quite swallow it.'"

This guarded attitude, which Lord Rayleigh doubtless maintained to the end of his life, is, of course, very far from hostility or rejection. Indeed, the words that I remember were a powerful argument in support of an interpretation based on natural selection. At the Leeds meeting of the British Association in 1890 I had given an evening lecture, exhibiting illustrations of mimicry and other uses of attitude, colour and pattern in animals, chiefly insects. Next day at lunch discus-

sion arose on the subject, and my old friend Professor Patrick Geddes maintained that the mimetic patterns of butterflies were produced by model and mimic without any relation between the one and the other. They were just "thrown off the wheel," as he expressed it—phases which had to be passed through in the life of a species. I pointed out in reply that such a hypothesis left unexplained the fact that certain groups, such as the Danainae, set the fashion in "phases" and were followed by other butterflies of quite different groups and often by moths, in the tropics of all the great land areas; furthermore, that they "threw off the wheel" various types of patterns, yet each was followed. For example, to take the Danainae alone, we can imagine hardly anything more different in appearance than the Oriental Euploeas are from the Oriental Hestias, or than both of these are from various Danaine genera in the same and other continents. Yet all these are freely mimicked. I still believe that this argument is sound and I have never heard of a satisfactory reply to it, but Lord Rayleigh met Professor Geddes' contention with a much simpler and more trenchant reply. "How would you apply your explanation," he said, "to the resemblance of insects to bark, or twigs, or leaves?" I have only met a single naturalist, and, as you will see, a singularly fearless one, who would have attempted to meet Lord Rayleigh's argument, and he was a most distinguished occupant of this chair—Dr. David Sharp, who, during one of the discussions in which we often indulged, maintained that there was more than resemblance, there was an actual similarity in structure between the wing of a long-horned grasshopper and the leaf of a plant.

No reasonable hypothesis has ever been advanced on this subject except the one which assumes that the adaptive appearances of insects—protective resemblances, warning colours, mimicry (Batesian and Müllerian)—have been gradually brought to a high pitch of perfection by selective destruction wrought by vertebrate enemies, above all by selection guided by the keen sight of birds. The existence of such keenness of vision is difficult to prove, its exercise in selection still more difficult. It is therefore of the highest importance for entomologists who are interested in evolution and its causes

to study carefully any evidence from whatever source which bears on selection as determined by the sight of birds. If it can be shown that the growth of other resemblances, quite different from the mimetic and protective likenesses of insects, but in some instances equal to the best of these, has never received a reasonable interpretation except by an appeal to the same causes, it is obvious that the hypothesis as employed by the entomologist will be greatly strengthened. To apply this outside test, as it were, seemed to me so important for the student of insect life that I ventured to choose for the address to the Entomological Society an Ornithological rather than an Entomological subject. Apart, too, from their bearing on our own science, the researches of which I propose to give a brief account to-night deal with an evolutionary problem of such interest in itself that I gladly authorised a grant in aid of illustration from the fund intended to promote the study of evolution, presented to my University by my friend Professor James Mark Baldwin.

The Evolution of the Colours and Patterns of Cuckoos' Eggs and its Relation to that of Insect Resemblances, such as Mimicry.

Two important papers on the resemblance between the eggs of Cuckoos and those of the birds they victimise have appeared in recent years.* In these finely illustrated memoirs—Stuart Baker's dealing with the Oriental Cuckoos, Jourdain's a comprehensive survey of the subject with a historical introduction and a list of the literature—both authors conclude that the resemblances can only be explained by selective destruction of the less like by those birds which otherwise would have been imposed upon. Other attempts have been made to explain the likeness. It has been suggested that the colours of eggs are influenced by the sight of the hen just before laying; also that the colour is determined by the nutriment provided in youth, the foster-parents, of course, supplying the young

* E. C. Stuart Baker: "Cuckoo's Eggs and Evolution," Proc. Zool. Soc., 1923, pp. 277–94.

Rev. F. C. R. Jourdain: "A Study of Parasitism in the Cuckoo," Proc. Zool. Soc., 1925, pp. 639–67. Quotations, page and plate references without mention of author or title are from this paper.

Cuckoo with the food normally given to their own chicks. Neither of these hypotheses has received serious support. One main difficulty felt by naturalists, especially in this country, when they are confronted by the hypothesis of resemblance attained by selective destruction, is the fact that here in England resemblance is so often wanting altogether. Jourdain's answer to this objection is of great interest.

It has now been satisfactorily proved that each female of the common Cuckoo has a special territory within which she lays, also that each female always lays one type of egg, generally in the nest of one species of bird, and generally removes one of the other eggs from the nest. Each male Cuckoo also has his special territory, but its limits do not necessarily coincide with those of a female. Mr. Stuart Baker concludes that the female Cuckoo is polyandrous. He informs me that he has seen several males pursuing a female, which paired with two of them and then went out of the range of his sight with a third male.

In the hilly districts and moorlands of the north of England, parts of the south, and in Scotland the Cuckoo normally lays in the nest of the Meadow Pipit, and the resemblance between the eggs is close, but the area over which this happens is so vast that Cuckoos' eggs are difficult to find and therefore rare as compared with more crowded stations. The wide extent of upland country supports a community of Cuckoos all laying one type of egg resembling those of the Meadow Pipit, and, as there is little invasion, the type keeps true. But in other districts, especially in the south, the Cuckoos lay in the nests of several common birds, breeding near together, such as the Pied Wagtail, Hedge-sparrow, Robin and Reed Warbler. We cannot doubt that the male Cuckoo is as important as the female in determining the colour of the eggs laid by their offspring. Mendelian researches in this subject would be deeply interesting, but, of course, extraordinarily difficult and perhaps impossible to carry on. We can, however, easily understand why the resemblance to the eggs of these foster-birds should be often wanting, when, under the conditions, the communities of females laying each one type of egg cannot be kept pure.

And confirmation is at once obtained by comparison with parts of the Continent where some of the same species of foster-birds occupy separate areas. Thus there are large areas where the Robin is the only fosterer, and here the standard of resemblance is much higher than in England.

Jourdain suggests that the want of coincidence between the eggs of the Cuckoo and the Hedge-sparrow is due to its poor sense of colour and the blunt perceptions which lead it to accept uncritically anything that is put into its nest.* C. F. M. Swynnerton has made experiments which prove that, among African birds, the Bulbul is equally uncritical. Very different results from ours are observed in other countries where foster-birds laying blue eggs like the Hedge-sparrow are the only species victimised by the Cuckoo. Thus in S. Finland the Redstart is the ordinary fosterer, the Whinchat an occasional one, both laying blue eggs, and Jourdain observed that of 40–50 local Cuckoo's eggs in the collection of M. Wasenius at Helsingfors, all but about 4 were blue.

Stuart Baker, in 1913,† was the first to suggest that the colour resemblance is due to elimination by the foster species, but that there is a high rate of mortality among nestling Cuckoos had been proved earlier by Owen. Methods of elimination which have been observed are—desertion, the destruction of the clutch, the ejection of the egg (which may be common but often undetected), and building a floor over it to prevent incubation. Thus a particularly critical Reed Warbler has been known to bury two Cuckoo's eggs at different levels in her nest: the eggs were of different types.

It is unnecessary to give further details, which may be found in Jourdain's paper. He concludes from the whole of the available evidence that "the proportion of rejections by the fosterer either by desertion or rejection varies enormously. In some species the percentage falls to as low as 5 per cent., or less, while in others it rises to nearly 80 per cent., and per-

* Mr. Stuart Baker suggests that the discrepancy may be due to the fact that the Hedge-sparrow is a recently selected fosterer, and he is beginning to find that rejections are numerous. He also considers that Owen's series of bluish eggs provides evidence that some adaptation is being evolved.

† "The Evolution of Adaptation in Parasitic Cuckoos' Eggs," *Ibis*, pp. 384–98.

haps in some cases almost to 100 per cent." (p. 652). It is very significant that the percentage of rejections is by far the highest with the rare fosterers. Here the Cuckoo is apparently seeking to establish itself on some new species and drastic selecton is going on. Thus the proportion of failures is extremely high with the Wren—a very unsuitable fosterer, it would seem, and yet one which the Cuckoo is making persistent efforts to adopt. The failures are also very numerous with the Wood Warbler, while with the Chiff-chaff they apparently reach 100 per cent., although the records are few. The regular fosterers give very different results. With these the period of drastic selection is over, an equilibrium has been reached, and rejections are only important as the means by which the standard is kept up. There is no uniform standard; the level reached is such as "to satisfy the discrimination of the host, but that level may be a low one or a high one, and varies according to the fosterer in question" (p. 652).

It is now necessary to compare these two results of selection determined by the sight of birds—the deceptive likeness of the Cuckoo's eggs with that of protective resemblance and mimicry in insects.

The Result attained.—It may be argued that it is a comparatively simple effort of selection which leads to the production of a blue egg instead of a white one by the more frequent rejection of the latter, and that such a process gives us no help in attempting to understand the evolution of a complicated example of insect mimicry. But there are simple mimetic patterns as well as complex ones, and complex patterns have been gradually evolved on Cuckoos' eggs by the accumulation of small inherent variations, as well as simple changes of colour. The production of the "scribbly" pattern on the eggs laid in the nests of Buntings in Japan (Pl. IV, figs. 1 and 5, 4 and 8) is just as wonderful as many an intricate pattern borne by a mimetic butterfly. Equally significant is the egg, also in Japan, laid by a Cuckoo believed to be of the same race (*Cuculus c. telephonus*) in the nest of *Saxicola t. stejneger*—an egg which on examination shows the Bunting-like pattern, but obscure and cloudy, and so modified as to promote

the resemblance to an egg of a type entirely different from that of a Bunting (Pl. IV. figs. 7 and 6).

Differences in Size.—It is interesting to observe that discrepancy in size, so often noticed in insect mimicry, is also very common in Cuckoos' eggs as compared with those of the host. It seems clear that differences in colour and pattern are more keenly appreciated by birds than differences in size. The comparison of the birds' egg and the insect is of especial interest, because we have not in the former any escape from the conclusion by appealing to distance. The egg of the Cuckoo lies with those of the host and the difference in size cannot be minimised, whereas the distant model may appear no larger than its smaller mimic near at hand. The fluctuating distances suggested by my friend Mr. F. A. Heron (Proc. Ent. Soc., Lond., 1903, p. lxv) as the explanation of discrepancy doubtless account for some of the observed differences, but the study of Cuckoos' eggs suggests that relative size is less potent than other criteria in determining the pressure of selection exercised by birds. Selection is, nevertheless, to some extent determined by size.* We can point to many instances in butterflies, and one of our Fellows, my old friend Mr. O. H. Latter, has detected differences in Cuckoos' eggs which support the same conclusion (*Biometrika*, Vol I, pp. 164–176, 1901). A good example of reduction in size evidently due to selection will be found on p. cii in the following section. It must be borne in mind, in estimating the critical powers of the host, that their own eggs

* Mr. Jourdain informs me that the characteristic thickness and close grain of the Common Cuckoo's egg are, he believes, indications that its size has been diminished. A dwarf egg of any species has a shell thicker than a normal egg. As most of the fosterers are small birds he infers that a general reduction in size has taken place, as in the N. American Cowbirds, which, although unrelated to the Cuckoos, are similarly parasitic and have evolved an almost exactly similar egg.

Mr. Stuart Baker also points out that in the most complete results of selection there is resemblance in shape and size as well as colour, *i.e.* in the eggs of *Clamator garulinus* and *Hierococcyx varius*, where the differences between the eggs of Cuckoo and fosterer are practically reduced to weight and texture. He agrees that size and shape are the two variations in degree which make the least impression on birds, and are therefore the least affected by selection; and suggests, as does Mr. Jourdain, that some considerable reduction has already been brought about in the eggs of Cuckoos, which lay in the nests of birds much smaller than themselves.

vary in size and that exceptionally large double-yolked eggs are occasionally laid. Variability in shape may similarly help us to understand the stability of the form of the Cuckoo's egg, this, with size, being the most obvious difference between it and the fosterer's, and generally continuing to persist when size is no longer discrepant.

Geographical Distribution.—There is a striking parallelism between the resemblances of Cuckoos' eggs to those of the fosterers in different parts of a wide area and those of far-ranging mimetic butterflies to their models. Beautiful examples are given by Stuart Baker, of which I may mention the Koel (*Eudynamis scolopaceus*), laying in the nests of five different species or subspecies of Crows in five different areas—Siam, Burma, Assam, N. India and Ceylon. The colour correspondences in each of these are finely illustrated in Plate II of his paper in Proc. Zool. Soc., 1923. The relationships of butterfly mimics follow exactly the same laws. Consider, for example, *Papilio cynorta* with its three females, in W. Africa, Uganda and Abyssinia, resembling respectively two subspecies of an Acraeine and one of a Danaine model (Proc. Ent. Soc., 1925, pp. li, lii, Pl. D).

Again, Stuart Baker * provides a case analogous to that of the Oriental *Papilio polytes*, with one female form mimicking *P. aristolochiae* over a wide range, and also a second form mimicking *P. hector* in the relatively small part of the range where the two models exist side by side. He tells us that the Large Hawk Cuckoo (*Hierococcyx sparveroides*) lays a bright, pale blue egg (figs. 16, 17) in the nests of Laughing Thrushes and other fosterers with blue eggs (fig. 18), over the whole of its range from the N.W. Himalayas to the Burmese Hills, but that in Assam it also lays a dark olive-brown egg (figs. 9–11) in the nest of a Spider-Hunter (*Arachnothera magna*), with a similar but much smaller egg (figs. 12–15). In correspondence

* P.Z.S., 1923, pp. 284–85. The figures quoted in the text are from Pl. III. The fosterer's egg referred to as 19 in the description of Pl. III should be 18, and the corresponding blue eggs of the Cuckoo 16, 17, instead of 16–18. It is perhaps unnecessary to point out that the facts brought forward by the author lead to the conclusion that there are in Assam two intermingled communities of the Cuckoo, one laying blue eggs, the other brown.

with the difference in size the brown eggs of the Cuckoo are smaller than the blue, but they are still very much larger than those of the Spider-Hunter. In this respect selection has done something but not very much (see p. c). The blue eggs of this Cuckoo are about as common in Assam as the brown ones, but the brown eggs are only found in an area about 700 miles long, where alone, in the whole range of the species, the Spider-Hunter (*A. magna*) exists in numbers sufficient to provide a suitable fosterer.

Another parallel is observed in the low standard of resemblance attained in islands as compared with continents. Among other causes it is probable that a more drastic selection on the larger areas plays an important part in both kinds of mimicry.

The Difference between the Inhibited Instincts.—It is important to remember, when we think of such a case as the Hedge-sparrow, that the inhibition of the instinct to incubate is very different from a brief postponement of the instinct to satisfy hunger. When hunger is extreme, as we know from Swynnerton's extensive experiments, the satisfaction is *not* postponed and a bird will eat the largest butterfly available, however distasteful. But under ordinary conditions, with plenty of other food about, the memory of an even moderately unpleasant experience called up by the sight of a pattern will operate and the insect will be discarded. It is very different with the incubating bird, well-nigh helpless in the grip of instincts released by internal secretions—part of a long train of sequences with earlier manifestations in courtship, nest-building and pairing, and leading on to a still greater helplessness when the young are hatched and being fed, and the deluded foster-parent responds " to the stimulus of the widely-opened mouth and the insistent hunger cry " of a nestling quite unlike her own. " At this stage rejections are almost unknown, and it is a fact that other birds beside the actual fosterers will respond to the insistent demands for food on the part of the young parasite " (p. 657).

A recent discovery of Jourdain's nevertheless indicates that certain birds of a high type continue to exercise selection at

this stage of the most relentless instincts. The Great Spotted Cuckoo (*Clamator glandarius*) lays her eggs in the nest of the Magpie in parts of Spain, usually removing one egg from the clutch. The resemblance between the Cuckoo's and Magpie's egg is strong, the size almost the same, but the shape different (Pl. IV, figs. 3, 2). The young Cuckoo does not eject the rest of the family, and they all live together.

"The first glance at a nest with fledged young of both species shows that the juvenile Cuckoo is quite a different looking bird to the adult. As it lies crouching at the bottom of the nest, one is struck by its black crown and dark back, totally different to the ashy grey of the adult, but bearing a superficial likeness to the young Magpies by its side" (p. 657, Pl. V). In another species of the same genus from India the adult Cuckoo (*C. jacobinus*, fig. 3) has a black head but the exposed parts of its nestling (fig. 3*a*) and the nestlings (fig. 6) of the fosterer are brownish.

"The natural explanation of this extraordinary state of things seems to be that the Crows and the Pies, with their superior intelligence, have enforced, by a process of selection, a certain degree of mimicry on the part of the young parasite in addition to extremely close resemblance in the egg" (p. 657).

Returning in conclusion to the conflict between the instinct to incubate and the disturbance caused by the sight of a strange egg, there is some evidence that a balance may be maintained for a time between the opposing forces. Thus Chance,* whose splendid work has added so much to our knowledge of this fascinating subject, has observed two examples of Cuckoos' eggs ejected from the nests of the Spotted Flycatcher after a period of many hours or even between one and two days. Then at last the balance was upset and natural selection prevailed!

I trust that Fellows will not feel aggrieved at this attempt to

* Quoted by Jourdain on p. 649. Mr. Chance has kindly informed me that in one case there is no doubt that the egg was thrown out within 36 hours and before the bird had begun to incubate. In the other, the period was undoubtedly longer, and he believes that the egg was ejected when the bird began to incubate. Mr. Jourdain also considers that the experiments of Rensch (J. f. O. pp. 461–472, 1924) certainly prove that a period of delay may precede ejection by the fosterer.

compare an Entomological problem with an essentially similar problem in the kindred science of Ornithology. I venture to believe that such comparisons are helpful to both.

In conclusion I desire to express my warm thanks to Mr. Jourdain, Mr. Stuart Baker and Mr. Chance, who have read through the proofs of this address, and given me much kind help.

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ERRATA.

Transactions, 1925.

Page 39, line 17, *for* 1902 *read* 1901.
,, 44, line 10, *after* "species" *insert* "and having been."
,, 48, line 25, *after* "me" *insert* "at Akaba."
,, 53, line 15, for *leucophlaea* read *campbelli*.
,, 54, line 12, *for* W[est] *read* E[ast].
,, 65, line 18, *omit* comma *after* "feeds."
,, 87, line 19, for "♀♀ are *albidice*" read "♂♂ are *albidice*."
,, 105, under *M. phoebe telona* range should be 23–36.
,, 106, line 5 from bottom, *for* Karima *read* Karim.
,, 109, line 3 from bottom, for "*triva*" read "*trivia*."
,, 119, line 8 from bottom, *read* "three main races, the first subdivided into a large dark coastal race and a smaller dark mountain race, occurring in the Beirut District and parts of the Lebanon respectively, which may be," . . . etc.
,, 219, line 16, for *Patula* read *Putala*.
,, 255, line 22, for *inuneta* read *inuncta*.
,, 255, line 9 from bottom, for *incornatus* read *incarnatus*.
,, 256, line 7, for *Eusthenes* read *Eurostus*.
,, 256, line 9 from bottom, *for* Colobathristid *read* Colobathristidae.
,, 256, line 5 from bottom, for *australiae* read *australica*.
,, 257, line 5 from bottom, for *Echtrichoda* read *Echtrichodia*.
,, 261, line 18, for *neavi* read *neavei*.
,, 262, line 13, for *cylpealis* read *clypealis*.
,, 262, last line, for *viridus* read *viridis*.
,, 263, line 22, for *nausika* read *nausikaa*.
,, 265, line 3, and p. 267, line 6 from bottom, for *Dictyoptera* read *Dichoptera*.
,, 266, line 17, for *Opiconsira* read *Opiconsiva*.
,, 266, line 2 from bottom, for *Rhincola* read *Rhinocola*.
,, 459, line 16, for *Theda* read *Thecla*.
,, 501, line 30, for *callipsyche* read *Callipsyche*.
,, 535, lines 18 and 19, for *stacyi* read *staceyi*.
,, 541, line 6, for *Chrysocoma* read *Chrysochroma*.

Proceedings.

Explanation of Plate A, line 7 from bottom, for *Brachinus* read *Brachynus*.
Page xi, line 14, for *biguttata* read *biguttatus*.
,, xxi, line 2 from bottom, for *apollinaris* read *apollinus*.
,, xxviii, line 4, for *P. mesentina* read *B. mesentina*.

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